DOCUMENT RESUME

ED 110 262 RC 008 711

AUTHOR Leadley, S. M., Ed.; Pignone, M. M., Ed.
TITLE Systems Analysis for Rural Community Services. A Seminar on Problems of Research on Delivery of Community Services in Rural Areas of the Northeast (Stratton Mountain, Vermont, July 29, 1972).
INSTITUTION Cooperative State Research Service (DOA), Washington, D.C.
PUB DATE 29 Jul 72
NOTE 69p.

EDRS PRICE MF-$0.76 HC-$3.32 PLUS POSTAGE
DESCRIPTORS *Community Services; Definitions; *Delivery Systems; Integrated Activities; Models; Objectives; Organization; Performance Criteria; Research Problems; *Rural Areas; *Seminars; *Systems Analysis
IDENTIFIERS *Northeastern States

ABSTRACT

Inadequacies in the quality and quantity of human services for Northeastern rural area residents prompted the seminar from which these transcripts are derived. Presented via chronological order, these transcripts reflect development of a framework and methodology for analysis of community service systems. Major seminar objectives are identified as: (1) explanation of what is meant by the systems approach, (2) analysis of the implications of systems model assumptions, (3) examination of the relevance of these assumptions as they relate to research, and (4) illustration of approaches to systems research. Among the facets of systems analysis explored are: (1) Research Models, (2) Definition of System, (3) Organization of Systems, (4) Overlapping Subsystems, (5) Feedback Mechanisms, (6) Ultrastability, (7) Accounting for Changing Systems in Research, (8) Feasibility of System Change, (9) Conceptualizing the System, (10) Criteria for System Boundary Definition, (11) Maximizing Efficiency under Changing Needs, (12) Impact of Subsystem on Larger System, (13) Dynamic System, (14) Maintaining the Level of Analysis, (15) Consumer Preferences, (16) Process in Housing Subsystem, (17) Model Complexity, (18) Criteria for Judging Performance of the System, etc. Major problem areas identified are integration of a subsystem, criteria used to judge a system, and establishment of the problem. (JC)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED110262

RECEIVED
SEP 9 1975
NMSU
E.R.I.C.

SYSTEMS ANALYSIS FOR RURAL COMMUNITY SERVICES

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

A Seminar on Problems of Research on
Delivery of Community Services
in Rural Areas of the Northeast
Stratton Mountain Inn, Stratton Mountain
Vermont, July 29, 1972

Edited by
S. M. Leadley and M. M. Pignone
Department of Agricultural Economics
and Rural Sociology
The Pennsylvania State University
University Park, Pennsylvania 16802

RC008711

0002

TABLE OF CONTENTS

	Page
PURPOSE OF WORKSHOP	1
SELECTING THE QUESTIONS	1
RESEARCH MODELS	2
NONSYSTEMIC MODELS	2
SYSTEMIC MODELS	3
ORIENTATION IN THINKING	4
DEFINING SYSTEM	4
THEORETICAL CONSTRUCT	5
DEFINING THE BOUNDARIES	6
ESTABLISHING BOUNDARIES	6
DEFINING SUBSYSTEMS	7
CRITERIA IN SYSTEM DEFINITION	7
COMMUNICATING	8
CONSTRAINTS	9
PREDICTING OR CONTROLLING SYSTEMS	10
SYSTEMIC/NONSYSTEMIC APPROACHES	10
PERCEIVING THE TOTAL SYSTEM	11
ORGANIZATION OF SYSTEMS	12
WHAT IS "SUM?"	12
GRASPING TOTALITY OF SYSTEM	13
INDIVIDUAL BEHAVIOR IN A SYSTEM	14
PRAGMATIC USE OF SYSTEMS MODEL	14
HIERARCHICAL ORDER OF SYSTEMS	15
OVERLAPPING SUBSYSTEMS	15
SUBDIVIDING SYSTEMS	16
IMPORTANCE OF LARGER SYSTEM	16
LARGER SYSTEM CONSTRAINTS ON SUBSYSTEMS	17
CRITERIA FOR DETERMINING SYSTEM	17
INTERNAL/EXTERNAL CONSTRAINTS	18
FEEDBACK MECHANISMS	19
PARAMETERS	19
IDENTIFYING CONSTRAINTS	20
PROCESSES IN SYSTEMS	21
EFFECT OF INTERNAL CONSTRAINTS	22
CONSTANT CHANGE IN OPEN SYSTEMS	22
ULTRASTABILITY	22

Page

TAKING ACCOUNT OF CHANGE OVER TIME 23
CHANGE IN INTERNAL CONSTRAINTS 24
CHANGE IN PROCESS WITHIN SYSTEMS 24
IDENTIFYING CHANGES IN THE SYSTEM 25
WHEN THE SYSTEM NO LONGER EXISTS 25
ACCOUNTING FOR CHANGING SYSTEMS IN RESEARCH 26

LEVEL OF CHANGE 27
OUTPUT AS CRITERIA OF PERFORMANCE 27
GOALS OF THE SYSTEM 28
SYSTEM MAINTENANCE AS A GOAL OF THE SYSTEM 29
SELF-PERPETUATING SYSTEMS 29
FEASIBILITY OF SYSTEM CHANGE 30

TEMPORARY SYSTEMS 30
SUBGROUPS AS INPUTS TO THE SYSTEM 30
DISSOLVING AD HOC GROUPS 31
TIME SPAN IN GOAL DEFINITION 31
GOAL ACHIEVEMENT VERSUS SYSTEM TENURE 32
CONCEPTUALIZING THE SYSTEM 32

PURPOSES OF DEFINING A SYSTEM 33
SYSTEM PREDICTION AND CONTROL 33
THE "REAL WORLD" IN BALANCING THE SYSTEMS MODEL 34
RESEARCH SYSTEMS CONSTRAINTS 34
RELEVANT AND POSSIBLE RESEARCH 35
RE-EXAMINING NE-77 CRITERIA FOR SYSTEM BOUNDARY DEFINITION 35

RESIDENCE AS A USEFUL DISTINCTION 36
COMPLEXITIES OF BOUNDARY DEFINITION 36
AGREEING ON THE TOTAL SYSTEM 36
TOTAL SERVICE PROCESS 37
RATIONALE FOR DATA COLLECTION 37
MAXIMIZING EFFICIENCY UNDER CHANGING NEEDS 38

DEVELOPING FLEXIBLE SERVICE RESPONSE 38
DEFINING THE TOTAL SYSTEM AND RELEVANT SUBSYSTEMS 39
WHAT ARE THE LARGER SYSTEMS? 40
DEALING WITH ABSTRACTION 40
A HOUSING SYSTEM EXAMPLE 40
IMPACT OF SUBSYSTEM ON LARGER SYSTEM 41

ABSTRACTING THE SYSTEM FROM OBSERVATIONS 41
PREDICTING WITH A SYSTEMS MODEL 42
IMPROVING THE MODEL 42
BUILDING A SIMULATION 42
IMPROVING THE SIMULATION 43
DYNAMIC SYSTEM 43

Page

INTEGRATING SUBSYSTEMS 43
OPTIMIZING THE TOTAL SERVICE AREA 44
CASE STUDY AS INTEGRATION TECHNIQUE 44
LEVELS OF ABSTRACTION 45
COMMUNICATING ON THE SAME LEVEL 45
MAINTANING THE LEVEL OF ANALYSIS 47

WORKING THROUGH A SAMPLE SUBSYSTEM - HOUSING 47
IDENTIFYING THE CONSTRAINTS 47
DISTINGHISHING EXTERNAL FROM INTERNAL CONSTRAINTS 48
OPPORTUNITY COSTS AS A FACTOR IN A RENTAL HOUSING SUBSYSTEM . . . 48
FACTORS IN PROFIT-MAXIMIZING BEHAVIOR 49
CONSUMER PREFERENCES 49

QUALITY VS. QUANTITY IN HOUSING PREFERENCES 50
MODEL OUTPUT 50
MAINTENANCE EXPENDITURES AND PROFIT-MAXIMIZING BEHAVIOR 51
PRAGMATIC USE OF THE MODEL AND EFFECTIVE COMPLEXITY 52
GENERALIZING THE MODEL 52
PROCESS IN HOUSING SUBSYSTEM 52

MODEL COMPLEXITY 53
BUILD CONSTRAINTS SLOWLY 53
APPLYING MODEL TO RURAL NEW ENGLAND 53
PROBLEMS OF OVER-SIMPLIFICATION 54
RESEARCH MODEL CONSTRAINT 54
GREAT EXPECTATIONS 54

TESTING ASSUMPTIONS 55
APPLYING MODELS REGIONALLY 55
CRITERIA FOR JUDGING PERFORMANCE OF THE SYSTEM 56
IS THE SYSTEM REGIONAL? 56
SPECIFYING THE OUTPUT OF THE SYSTEM 56
THE RESEARCH COMMITTEE AS A SYSTEM 57

WHAT ARE THE OUTPUTS OF THE SERVICE-DELIVERY SYSTEM? 58
POINT OF PROVISION AND POINT OF UTILIZATION 58
OUTPUT SPECIFICATION NECESSARY FOR RESEARCH 58
TENTATIVE DEFINITION OF THE MODEL 58
CONCRETIZING THE MODEL 59
ADDITION OF SEASONAL HOUSEHOLDS AND TRANSIENTS 59
LINKAGE SYSTEMS 59
OUTPUT IS EFFECTIVENESS OF DELIVERY SYSTEMS 59
REVIEW OF ANALYSIS 60

00005

PREFACE

A cooperative rural social science research program has been carried on since before the beginning of the Twentieth Century by the U. S. Department of Agriculture (USDA) and the Land-Grant Universities. This program is presently administered federally by the USDA's Cooperative State Research Service and in each of the states by an Agricultural Experiment Station. When the nature of a research problem justifies the need, these state-based Experiment Stations are empowered to jointly sponsor an investigatory effort.

In 1969 and 1970, among a small group of agricultural economists and rural sociologists located at ten of the Land-Grant Universities in the northeastern United States, there emerged a consensus concerning a current and serious public problem. It seemed that the quality and quantity of human services for persons residing in nonmetropolitan areas of the Northeast were inadequate; any balance that might have existed in the past, between providers and consumers of these services, had been destroyed by ubiquitous and rapid changes sweeping American society in the 1950's and 1960's.

This small group of researchers, building on their consensus about the seriousness of the rural community services problem, further agreed that a better understanding was needed of the dynamic relationships influencing the availability and use of community services. Their concerns were transformed into a formal research proposal which was funded in April, 1971. Dealing with both description and explanation, the proposed research objectives focused on the economic, political and social assessment of public policy alternatives for correcting imbalances in the mix of human services on which nonmetropolitan residents of the Northeast depend.

Initial deliberations of the research planning group, the NE-77 Technical Committee, identified four-service areas on which their efforts would be concentrated; namely, education, health, housing, and welfare and social services. Subsequent changes in staff and research commitments of the participating Experiment Stations necessitated deletion of analysis in the area of welfare and social services.

From the earliest planning conversations, social scientists expressed concern not only for individual services but also for community service-mix analysis. Although few empirical investigations have been reported on this topic, the conceptualization and measurement of the combination of services available for residents of any community assumed a high priority in the project's work plans.

A goal that has proven most elusive for the project participants is the explication of an integrated conceptual framework. The utility of such a framework is obvious and unquestioned; the task of creating it, however, has not been without its frustrations. Individual subcommittees of the Technical Committee have struggled with concepts and hypotheses; two individual researchers prepared lengthy working papers for a national workshop on community services research methodology; the Technical Committee has debated pros and cons of alternative paradigms; and, the committee's chairman attempted to further elaborate these schemes in an extensive research-planning paper. All these efforts have contributed to an evolving research structure. But, the seriousness of the community services issue suggested that some means should be sought to speed up the development of the framework and research methodology.

Chosen from among several alternatives to accomplish this goal of more rapid progress was a seminar on systems analysis. After an extended search for specialists in this subject, Drs. David Hardin and Verl Franz from Loyola University of Chicago were engaged to act as seminar leaders. During a preseminar orientation, they were provided with written documentation of the Technical Committee's efforts to arrive at an adequate conceptual framework. They were also given an up-to-date report on the participating researchers' work-in-progress as well as the expressed needs of these individuals related to systems analysis. Funding for the seminar was provided through the several participating Experiment Stations. In attendance were social scientists from Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, West Virginia, and the U. S. Department of Agriculture.

In addition to a series of short lectures by the seminar leaders, the participants became involved in lively discussions. Concepts and relationships were questioned, applied and evaluated. Examples were sought in order to bring the ideas into the working frameworks of the researchers. We have attempted in the editing of the seminar transcript to retain this richness of definition, discussion and debate. Rather than collect all lectures and debate on each subject into separate sections, we favored a chronological approach by which the ideas are presented as they emerged over the day-long experience. Attention to the above objective through this approach resulted in occasional discontinuities wherein the seminar shifted abruptly from one topic to another due to a participant's question or at the leader's direction. Topical headings and marginal notes were added as a means of helping the reader to overcome these changes in either lecture or discussion topic.

The experience captured in this publication was one of inquiry. Further, neither the participants nor the seminar leaders were interested in this effort as an intellectual exercise or a prestige-building academic debate. Thus, the questions reflected a quest for understanding and the debate was indicative of the group's continuing search for a working framework within which their work might be organized. For those who were present, the text will serve to refresh memories and provide a basis for continuation of their search. For others, who did not have the opportunity to share this experience, the text may help to advance their efforts to construct a more adequate research base. Hopefully, out of these efforts will emerge a better understanding of the dynamic relationships influencing the availability and use of community services for nonmetropolitan residents in our nation.

Samuel M. Leadley
Mary Margaret Pignone

University Park, Pa.
November, 1972

Before we begin, I think that it would be well if we had some understanding of what we are not going to do as well as what we are going to try to do. My background is in organizational theory or organizational behavior. I will not attempt, however, to give you a mini-course in organizational theory nor a review of the literature of organizational behavior, bureaucracies, etc. The concept of the workshop is a systems approach. Therefore we will attempt to do the systems approach. Time will not allow us to go into mathematical detail on how to conduct transportation models, dynamic programming, forecasting and so forth. We will touch on some such techniques, however, as they might be useful to you in different aspects of your research. Finally, we cannot solve your specific research problems. We can only hope to provide some insights into how you might go about solving your own problems or eliminating them. Some problems are not problems when you look at them from a different perspective.

PURPOSE OF WORKSHOP

What we will do therefore is 1) explain what is meant by the systems approach; 2) develop some implications of the systems model assumptions; 3) examine how these assumptions relate to your study and research; and 4) illustrate how you might describe the system(s) you are talking about in your research and how you might approach some of the problems you encounter in those systems.

SELECTING THE QUESTIONS

Albert Einstein was getting on in years when he began searching for the nature of electricity. He was often heard to say, "I wish I knew what questions I should be asking myself." That is probably a good point from which to begin our discussion today. We need to be able to formulate the important questions or the "plague" questions as they might be called. What questions are plaguing your research, stopping you from getting where you want to go? Jot down some of those questions. Then, as we go through the discussion of the systems approach, you might find some ideas that will relate to your problems. Make a note of those ideas or list new questions. At the end of the discussion we would like to come back to your original questions and show you how you might solve or eliminate some of your problems.

Plague Questions

Sample Questions

Several questions that I have already noticed emerging from your research are: Should your system be efficient or should it be effective? Who is to determine what is effectiveness or efficiency? What is the system? What is a rural community services system? What is adequacy? When is a service system adequate and who is to determine this? How do you gather data about the systems under research? How do you integrate the findings from one area like housing with another area like education or medical services?

RESEARCH MODELS

What is a Model

Perhaps the first thing we need to know is what is my meaning of a model? A model is not what one actually sees or observes. In fact, we expect some divergence from reality in most models that we build. Nevertheless, even though we have inexact models we find that to deal with phenomena we have to make use of models. They are necessary and essential part of the process. There are a multitude of types and kinds of models that we might use. For the purposes of this workshop we will confine our discussion to research models.

Model Defined

By "research model" we mean a strategy that will help us select and measure a system's variables and relationships that we want to study. (You will notice that we are not claiming that it is the only strategy to follow or that it is the perfect model.) Research models can be dichotomized into two major areas, nonsytemic models and systemic models.

NONSYSTEMIC MODELS

Isolating the Relationship

Generally, in a nonsystemic model the researcher focuses on a particular relationship and seeks to prove its generality or measure of magnitude. By isolating one particular relationship the researcher hopes to isolate the variable that he is investigating from its environment. In this way he hopes to increase his understanding of the real essense of the variable. This model is the same model used in a research laboratory. Control your conditions. Look at the variables. Observe what happens.

Reducing the Problem Size

Essentially, the reason that this strategy has been followed is for the express purpose of cutting the problem down to size. Investigations of this type have been carried out with a variety of methodologies which range from artificial behavioral

experiments with live subjects to laboratory studies where the effect of changes through time of one variable on another is noted. When "solid" findings are achieved we have one more relationship that we add to our knowledge. Unfortunately, the implications of the one bit of knowledge as to how it relates to the larger system is generally unknown.

Relationship to Larger System Unknown

Conditional Findings

The nonsystemic approach does not define what relationships are worthy of investigating. This is left up to the researcher's intuition. In the nonsystemic approach the role of other variables is normally omitted in any of the findings. Since they are omitted, many findings are highly conditional. "If you live on Elm Street in a green house with a red roof this will hold true." When the larger system is left out of the research the implications of the findings are left to intuition. It is due to the presence of these shortcomings that has caused a number of people in various disciplines to turn to the systemic approach.

SYSTEMIC MODELS

Total System Focus

The systemic model in comparison to the nonsystemic approach focuses on the total system rather than on the individual components. (Let me point out here, that the terms "system" and "organization" sometimes are used interchangeably. An organization is a system. A system is an organization.)

Totality of Relationship

The system is assumed to be not merely a totality of unites, each governed by laws of causality operating upon it. We assume in a systems approach that the totality of relationships among these units is what we are going to be looking at. The emphasis is on the organized complexity and this is the essential concept of the systems theoretic view.

Interacting Parts

Another important assumption in the systemic model is that we assume that the activities of any part of the system has some effect on the activity of most of the other parts. Thus, if we are going to evaluate any decisions or action in a system we need to identify all significant interactions and evaluate their combined impact on the performance of the system as a whole.

Understanding the Overall Behavior

A third point to remember is that understanding the overall behavior of the system is considered the

main goal of systemic analysis. Example: an automobile is not operating correctly. In a non-systemic approach you might look for one component, the carburetor, or the spark plugs. But by putting in one new part you may cause to malfunction two or three other parts of the automobile. To understand a malfunctioning system you need to look at the malfunctioning of the system as a whole.

Perceive System as a Whole

ORIENTATION IN THINKING

More than Techniques

We should note here that the systems approach is used to orient our whole thinking process. It is incorrect to view the systems approach as merely a set of techniques for solving problems. It is, instead, an outlook with which many of us are unfamiliar. Our spoken language discourages thinking systemically. The written word also is basically a linear form and to describe a system in linear terminology is very difficult. Probably the Oriental mind is most tuned to thinking in systems, to thinking in the overall total.

DEFINING SYSTEM

Now that we have some idea of what the systems approach is we need to look at what a system is. What is a system?

Comment: Input and output.
Comment: Network of interaction.
Comment: Collection of black boxes - interrelated.
Comment: Interdependent interactions.
Comment: Interactions governed by norms or standards not just random interaction but with some regularity.
Comment: Interactions between positions.
Hardin: How do you define the system in your rural community services area study? What do you want to include in your system? Obviously, you are going to be talking about human beings. But do you want to limit it to human beings?

I can give you two other more formal definitions. A system is a distribution of members in a dimensional domain. A system is, roughly speaking, a bundle of relationships. A system is an organized or complex whole. A system is a configuration of components interconnected for purposes according to a plan. Basically, this is how "system" is defined in the literature. It is not very useful, however, because

what all these definitions say is that a system is a collection of interacting systems. They are tautological, defining system by the term itself.

To come to a clearer definition of system we need to go into the theoretical construct of the systems approach and then bring the discussion from the theoretical back to the practical with more clarity. We will know what assumptions we are making about systems and thus, what can be considered a system and what cannot be considered a system.

THEORETICAL CONSTRUCT

Example: Universe as System

Let us take the universe as an example. The universe, we are going to assume, is made up of matter and energy. Matter is basically potential energy in a rest state. We believe in the law of conservation of energy that says we can neither create nor destroy matter and energy. There is only a certain amount of it in the universe. Matter we

"Objects" in the Universe

differentiate into what we call elements, components or objects. Each object in the universe that we might isolate is part of a distinguishable set of objects and each object, in turn, is made up of

Levels of Differentiation

other objects or components. You can focus on the object "matter" at different levels of differentiation. You might also think in terms of individual cells that make up an individual, individuals that make up a group, etc. It is the same basic concept.

Activity Defined

We define activity as a change in an object. The change can either be in the makeup of the object, or in its relationship to other objects, or in its spacing of itself in the universe. Notice: we say we define an activity as one of these three things. It has to change its makeup, space or relationship with another object. Now, when a number of activities takes place such that each activity directly or indirectly is related to at least some other activity or activities in a seemingly more or less stable way within a specified period of time, we say we have a system.

System Defined

Elements of the Definition

Let me elaborate. We have a number of activities. The number is determined by the observer, who, in his judgement, believes those activities are related directly or indirectly to other activities. Some have believed, for instance, that sun spots caused

wars. They saw a number of activities related to another activity - sun spots - and drew conclusions from that.

The relationship must be more or less stable. It cannot be totally random. If it were totally random then one would say that there was no relationship between one activity and another.

Finally, the relationship must extend over some specified period of time.

DEFINING THE BOUNDARIES

Observer's Role in Definition

It is important to note that under this definition the determination of and the extent of a system depends solely upon the observer and his ability to make order out of perceived matter and energy in a universe. What this is saying is that there is no a priori system out there. By definition or assumption everything in the universe is interrelated. A system is our ability to determine the number of activities, what objects we want to look at, what relationships we want to assume, and over what span of time. One of the most important concepts in the systems thinking is that the burden is on the observer to define the system. The observer for his own purposes and on the basis of his own characteristics selects from an infinite number of units and relationships a particular set that he wants to observe. He arbitrarily establishes the boundary of his vision and asserts that this much alone will be accepted as being his system. The system is what you say it is and is given boundaries only for the purposes of discussion and study.

System is What You say it is

ESTABLISHING BOUNDARIES

Criteria

How would we separate the boundaries between systems? Where does one start and the other end? You have to use some criteria. It may be that you have forgotten what your criteria were when you made the separation between your system and others. But the separation could be made at the point you have chosen because there is no separation out there that you necessarily have to make. If you are going to talk about health services, and if an individual is within your physical system, do you include him in as a nonmetropolitan person because he is in a different area, or in a car instead of a house and so on?

DEFINING SUBSYSTEMS

The same thing holds for your subsystems. I noticed you had the system split originally into three subsystems, health, housing, education and welfare. Then I noticed that you chopped off the subsystem of welfare as part of your system. Why are you no longer dealing with this subsystem? Well, if I understand correctly, there is another project that is studying this subsystem. Essentially, you define the rural community services area as these three subsystems.

CRITERIA IN SYSTEM DEFINITION

Elements, Activities and Linkages in System Definition

Inasmuch as the observer determines the elements, the activities and the linking of the activities that form the system, systems can obviously be made to appear or disappear by just changing these specifications. Change the elements, change the activities, or change the linkages and you will have a different system. The big key to finding a system worthy of study is the criteria that you use. What are the major criteria that you use to define systems? Why do you have problems bounding your system? Why do you look at certain aspects? Why do you say, what is the education system? Which one are you talking about?

Example

The System Exists

Comment: Because, it seems to me, there are identifiable points in the total universe where individuals can make an impact or change the system.

The System Exists Because We say it Does

Hardin: But you are making the assumption that the system is already there, and I can define your system away from you. We will get into that in just a minute, the possibility of defining it away from you.

No, it is Really out There

Comment: How can you define away the existence of a school board that is legally elected? The school board is an integral part of the structural system. No matter how you conceive the system, the school board is there.

Hardin: Which system are you talking about?

Comment: We were talking about the educational system.

Hardin: The educational system?

Comment: I can define the educational system to meet my purposes.

Hardin: Right.

Comment: But if I overlook the fact that there is a legally elected school board there, I am going to make little or no impact. I can make no change. I can make no additions or subtractions until something happens to that school board. I can define it in a billion different ways. The fact remains, it is there.

Agreement on Definition

Hardin: How are you going to define the educational system? If you didn't define the school board, how are you going to change the school board? Or change the educational system? What do you have to do? If you look at the educational system you are talking about, what has to be true to talk to somebody else? You have to agree about the system you are discussing.

Comment: That's my problem with the way you are defining systems. You seemed to be saying earlier that one can define the system as he sees fit.

Hardin: Well, the point I am trying to make is that, once you realize that you can define the system any way you want, the crucial criterion is to be able to communicate. For instance, I couldn't talk about your educational system unless I included the school board. Otherwise we wouldn't be able to talk about it. We wouldn't be able to talk about your concept of the education system.

Comment: Could it be then that there is a school board existing but perhaps we don't want to look at it? We are going to define this system only as one school which has an administration, and teachers and so forth and that's the system as far as we are concerned. The school board exists as another system or it may not, but we're not concerned with it. Is that what you mean by saying, "we define the system?"

Hardin: Let's take a school board, as an example. The school board itself we could define as a system. The school board is a system made up of people that interact and so forth within a time frame. There is a local school. It has an administrator, has teachers, has students.

Comment: I left the students out.

Hardin: Well, but you see, notice if you are talking about the school system it has to include students. Now, under our definition of a system, both are possibly worthy of discussing but if we are going to talk to each other and make sense about what we are saying, or if we are going to be able to predict what will happen to the school, or if we are going to be able to control what will happen to the school, we've got to have an understanding of what system we want to talk about and at what level. On your system one of the constraints will be the students. You see this system being constrained by students, and this turns from an external constraint essentially to an internal one. In other words, it just becomes a part of the system. Now the big key is to make sure that when you are talking about your system, and want to make predictions or controls on it, that I know what system

Clarifying Definition

you are talking about. In other words, a lot of your problems in research stem from not clearly defining the systems you want to discuss.

CONSTRAINTS

Level of Abstraction

Comment: You used two words that at least make sense to me and they were external and internal constraint. I think that was where we were having our trouble. We were including in the system some things that were tangential to the system, but which at a different level of abstraction could have been within the system; that is, the national educational policy, the state educational policy, the whole state administration system, the schools and counties. In this system you are looking at one specific school district.

Hardin: Notice how difficult it is even to explain a systems approach because we are using a linear form. We have to go through step-by-step. Right now we are talking about criteria. Setting up certain constraints or types of constraints of understanding will be part of the criteria that will help us reach an agreement on what we are going to consider or identify as external, internal constraints, inputs, outputs, and so forth. We are coming to that. But I think it is important to recognize the fact that we need to have the acceptance of others. We cannot just say that the system is there, and, because we say it's there, that it's a system worthy of talking about. I have to convince someone else that's a system. If not, I am just sitting back, talking to myself.

Acceptance of Others

Applied Research

Comment: What we are interested in is applied or action research. We may as researchers define what we think is a system. Then we go to another person; he may be a state legislator or a policy maker. They can't understand what we set up as our system. In other words, among ourselves we may finally have agreed upon what is a system. But when we go to the next step in trying to apply the results we've got the whole problem of communication all over again. This would seem to indicate that we would need to go out first to involve the users in defining our problem and setting our criteria.

Involvement of Users in Definition Process

User Readiness

Hardin: Well, one obvious thing is that if you know others have an impression of what a system is, and they don't include an element that you think is important you don't try to tell them they ought to include your element. They are not ready to include it.

Research Concept Versus Policy-Maker Concept

Comment: I think this is what we do as researchers sometimes. We set up our own concepts, models and systems. They may not be related to what the policy maker understands as the system.

Hardin: The user has a concept of what the system is and the constraints on it. If this thinking doesn't mesh with your system you have a problem. You are talking about apples and he is talking about oranges. They are close. But when you start getting down to doing something with apples and oranges you run into some problems.

I hope to point out later there are only two things that we attempt to do in systems. You either want to forecast where the system is going to go or we want to control it.

PREDICTING OR CONTROLLING SYSTEMS

Comment: In terms of language you used earlier, to predict is to say, "We know what the activities among the elements are going to be."

Hardin: You have to say the system is going to be somewhere in the future. You are saying, "Given the relationships of the activities and elements to the system now, I can tell you in the future what this relationship is possibly going to be."

Comment: Okay. With or without control?

Hardin: Well, in one case if I'm not doing anything to the system I am clearly predicting. If you want to do something with the system, then you want to not only predict where it would be but you want to say, "What can I do to the system to get it towards where I want it to go."

Review of Discussion

Comment: What you have shown me so far, is this: In the beginning you defined the difference between systemic and nonsystemic research. In the nonsystemic approach you took one variable, or one relationship and manipulated it. But that wasn't so good because there are other variables and relationships that affect them. But now you are taking one system which is a part of a larger system, unless you are taking the universe and we assume that we would not deal with that right here. How do the systemic and nonsystemic approaches differ?

SYSTEMIC/NONSYSTEMIC APPROACHES

Nonsystemic: One Relationship; Static

Hardin: Well, I think the difference is that from a nonsystemic approach you would go from taking the variable X and predicting where it is going to be, one relationship. And systems, we could take X as a system and predict where it is

going to be. If we took X and combined it with Y, this may help us predict but it won't tell us the whole story about what the system is going to be. It is not adequate. So that in order to talk about systems we must get beyond isolated variables. What we have to talk about is, in a sense, dynamic. For a lot of relationships we may never actually know what the interaction is between variables. But, we are observing the total rather than the individual components within the system.

Systemic; Many Relationships; Dynamic

Comment: As Dave pointed out, in the nonsystemic approach every prediction is conditional; you must specify the conditions under which X will lead to Y, because that is your laboratory control, or your statistical control. In the systemic approach you are not concerned with conditions; you are concerned with where the system as a whole will be, taking into account the internal and external constraints.

Comment: Don't you have to know each individual variable, and what effect it will have in order to develop a definition of the interrelationships of the system?

PERCEIVING THE TOTAL SYSTEM

Comment: That would be a little difficult to do under the assumption that the system is more than the sum of its parts.

Comment: In terms of predicting could the distinction be made between a nonsystemic versus a systemic approach on the bases of linearity and additivity?

Example

Hardin: Yes. If you knew a farmer and you looked out on his crop and you said, "Beautiful crop, beautiful crop." The farmer might say, "We are going to have a poor crop this year." All the individual variables might say you are going to have a tremendous harvest of each plant. If you asked the farmer why he feels that way, he would say, "I just know we are going to have a bad crop." What essentially he is saying is that he has a system. He's not able to identify some of the things he is considering but beyond that he is taking in a feel for the whole system and predicting at this point in time a bad crop, even though all the individual components might look like he is going to have a good crop. You are dealing here with a combining of components and a synthesis of them. But there's not necessarily a causal link between each one. You don't know how they fit in together, you just know that probably this is where the system is going to end up.

Synthesis of Components

Comment: The fact that you said that the system is more than the sum of its parts cleared up some of the confusion.

Synergism

Hardin: This is one of the assumptions of the systems approach. The behavior of the system cannot be explained by knowledge of the behavior of one or more of its subparts. In other words, if you went through and polled every individual you would still not necessarily have the group's opinion. There is something more there. This is often called synergism.

Comment: Those of you that do small group work certainly are aware of the difference between the majority vote and consensus.

ORGANIZATION OF SYSTEMS

Hardin: Now, if you stop and think about it, what is the one component that a system has other than just its parts? There is one characteristic. For example, take six people, line them up into two lines, then take the same six people and put them in a circle. Do you have the same behavior? If you take a pile of bricks, each individual brick is just a brick. You see that it's a pile out there and you come back the next day and you see all the same bricks, but now they are formed into a wall. What is the difference? All the components are there. There is no difference except one thing, and that's how they are organized. So the key to the fact that the system is more than the sum of its parts is due to the fact of organization, or how they are arranged.

Arrangement of the Parts; key to Overall System

Comment: Can a matter of stress enter in there? How the bricks stress on each individual brick is different when they are built up into a wall, the stress on each brick becomes different from what it was in the pile.

Change in System Organization

Hardin: There are many ways you change the organization. You can change stress; in the group phenomena for instance you can change relationships so that the people will speak out or not. You can change a multitude of things just by changing these same components around into different configurations.

WHAT IS "SUM?"

Comment: When you say the system is more than the sum of its parts, one of the things that bothers me is what do you mean by "sum?" Do you mean a product? There are a lot of different ways of relating inclusive parts. When you say "sum" this implies an additive approach, but what you're saying here is that there are many ways of relating parts that neatly correspond to the relatively few number of mathematical ways of combining objects, such as taking the sum. Are you saying there is some other way of combining parts?

GRASPING TOTALITY OF SYSTEM

Polling versus Synthesizing

Hardin: In research the approach basically is to investigate one variable, then another variable and then "add up" the findings to determine something about the situation. In the political science field they have studied how people act or how a decision is made. For that information they will poll individuals. They see who is involved in the situation and ask how the decision is made. They take a consensus of the individuals and reach a conclusion. What they find is that these conclusions are not necessarily accurate. What they have done is polled each individual subsystem but these data don't accurately predict action. Why? Given the individual within the subsystem, his perception is limited to what he can see. Thus, by the sum of its parts, one is really saying we can learn by looking at the individual parts of a system. But when we talk about the system as a total we have to recognize that all these little bits of information must be synthesized into some cohesive whole. Every school system has administrators and teachers. However, the way that the school is set up internally possibly will effect what happens in that school system, determining whether it is a good school or not.

Sysiem, a Cohesive Whole

Comment: In trying to get at the totality of a system in terms of behavior and action, it is that instead of simply polling individuals, you poll them in terms of their relationships, their behavior towards others in the system?

Hardin: If you poll individuals to get their perception of the larger system you must keep some-things in mind. We run into problems when we make a prediction or try to control a system. If you take what each individual said about the components as gospel or you try to add it up and say whatever the majority feels is right, you are probably going to run into problems. How do you get a feel for the whole?

Fitting Perceptions Together

Well part of it is knowing through experience how to fit perceptions together. If you fit perceptions together in such a way that one individual's opinion is worth more than another, how do you arrive at that weighting? I don't know how to do that mathematically. I can weight them when I look at the overall picture with the four or five different perceptions. I have balanced them in my mind. Then you determine what is going to happen to the system.

Compared to Mob Psychology

Comment: Is this like a kind of mob psychology? For instance, you have ten individuals and you have interviewed them separately and nine of them seemed to be fairly rational and reasonable people and one of them is a Demagogue. You could say that 10

percent of the group was a Demogogue. Then, if you put them into a group, unless they do not interact, the Demogogue could conceivably create a mob psychology among the whole group which you would not have been able to predict if you took them as single individuals. Is this the type of thing you are saying?

Political Example

Comment: Let's take an example in this political year. Some people are going to be talking about the election nationally. Other people are going to be talking about the election from their precinct point of view. If you add up victories in all the precincts, that still will not necessarily equal the national victory. Or, the precinct victory might be by a greater margin than the national victory.

INDIVIDUAL BEHAVIOR IN A SYSTEM

Hardin: When we talk about human systems we are very subtly saying that a human being as an individual does not have complete free will. His behavior is part of a system. To a certain extent he will be able to vary his behavior. But in mob action, for instance, it is very difficult not to be part of the mob. How do you explain the behavior? The only way you can do this is to look at the total and not just the individual.

Synergistic Mechanisms Unknown

Comment: Is there in this a suspicion that the synergistic mechanisms will never be known? Is there a kind of eastern mysticism about synergism floating around that bothers people?

Comment: It may never be known and maybe it's not even worth being known.

PRAGMATIC USE OF SYSTEMS MODEL

Pragmatic Use of System Models

Hardin: That is a big key to understanding. If I have the wrong technique and the wrong understanding but I can predict where systems are going to go, or I can get them there, that's all I care about. To put it bluntly, I am doing something right. I may have a completely wrong system but that system as I have used it somehow gets it there or the control item gets it there. I am not so concerned about being sure that I have the best way to do it. Later I will give you another criterion or assumption that will try to get you out of that thing which is to say there is only one best way to run the system, or there is only one place the system can go. Now, again, most of our research and schools have driven it into us that we look for the best way, or we look for knowledge. Notice I keep saying this. Predicting or controlling may help us lead to knowledge and understanding, but not necessarily.

No Best Way

HIERARCHICAL ORDER OF SYSTEMS

Subdividing Systems

Now, from our definition of systems, given any system we can subdivide it into subsystems. And, if we wanted to, we could take the subsystems and divide them into subsystems. Now the partitioning of a system into its subsystems is often called the hierarchical order of systems. This says that we may for purposes of research want to talk about the rural community services area or system. Out of this we are taking some components or subsystems, three of which are the health, education, and housing subsystems. Out of each one of these we may want to take its subsystems by states, and you may want to go on down. Now notice how our assumption before about the system being greater than its parts is important here. We can make statements about community services at the county level, but notice to make statements at the state level we are going to have to include something else in there; for example, the makeup of the total of the state. You have to synthesize one into the other.

OVERLAPPING SUBSYSTEMS

You can make some statements about the total system and community services, but then you are not only including in these three subsystems but possibly other subsystems, like the welfare system. You can take the health subsystem and subdivide it. Now, what belongs to the health subsystem? You probably would include hospitals, obviously. You can include rural doctors and their offices and their nurses.

Comment: How would you include school health work for instance, the school nurse, or health education programs? Would you then be going into another subsystem?

Hardin: We have a subsystem that is overlapping.

Comment: It is a linkage system.

The School Nurse: A Linking Role

Hardin: This does not mean that we cannot talk about this subsystem which is highly constrained by another subsystem. In other words, we are only doing it for our understanding of being able to control. If we leave out the school factor for these nurses in the school we are incomplete about some major subsystems we need to discuss.

Comment: But it won't be a part of the education subsystem. Instead the nurse role would be a link; therefore, what happens?

Problems of Classifying Persons Within Subsystems

Hardin: The person in the education system is not going to leave out the nurses in his subsystem necessarily because that is part of his system. What about the druggist as part of the

health services? I talked to a number of druggists that would probably do more prescribing than doctors do. Can you talk about the health services if you leave out this major subsystem? Is it a major subsystem? Who decides whether it is or not? It may be true for one state but not another.

SUBDIVIDING SYSTEMS

Whenever you have some policy or a fractional policy to control or change the situation you've got to be aware that there are differences in these subsystems. So, we look for similarities and differences in the subsystems. If you assert a collection of things is a system, that does not deter you from dividing a system into parts for the sake of description. Any arbitrary division is a logically admissable subdivision. Again it revolves around getting agreement upon what are worthy subdivisions or subsystems to talk about. Probably one of the criteria that we use most of the time is the one of convenience.

Determining Lines of Division

Now we need to be careful, however, if we are going to make subdivisions. If you are interested in a total system it is important that you don't destroy the essense of what you are going to try to do. For instance, if you went to the doctor for a migrane headache and he cut your head off, he destroyed your system. In other words, you've done something to the subsystem or to the behavior of the subsystem that is destroying what you really had as your whole purpose to do in the first place. For example, if we are talking about the health system, I don't think we could really be realistic about this large system in some communities if we chop off the druggist from the system or if we eliminated the school nurses. They have an effect on the system. So we have to be careful that when we subdivide it we don't make what we refer to as a dangerous division. That means that we have divided the system in such a way that we are not getting an adequate description or we are destroying too much of the system that we observe.

Dividing too Radically

Dangerous Divisions

IMPORTANCE OF LARGER SYSTEM

To show how predominant this type of subdivision can be, in the business world there are case-after-case of advertising and sales departments that go out and do a heck of a job. Everything that can be produced they sell. In fact, some salesmen will sell things that haven't even been made. Then, you go into the engineering department and engineers are producing

Optimizing Subsystems Versus the Total System

things that salesmen can't sell or they are designing things that are too costly to sell. What is happening? There is a division between two subsystems that says that we get desirable behavior in both subsystems but what are we doing? We are optimizing each subsystem independently are we not? Salesmen are happy, they're selling products. The engineers are happy they're making products. But, the company is going bankrupt. There's no larger system that says it's only good when these two things combine into one system. In other words, we only want to sell things we can make. I've seen a lot of companies lose a lot of money because of this. It is a very, very fundamental concept.

Probably a reason some of the practical applications of our research never really work is because we try to do one thing at a local level, for instance, and really what we should be doing is trying to get some change at the state level before change below is even feasible. Here we're saying the larger system constrains the subsystem and how it constrains it will determine where the subsystem can go.

LARGER SYSTEM CONSTRAINTS ON SUBSYSTEMS

New Hampshire Example

Comment: We may have a good example of this in New Hampshire at the present time. In an effort to upgrade rural health services, legislative boards passed a law making it mandatory for ambulance attendants to have a certain level of skills. But we have a lot of volunteers - people who don't have those skills. What is happening is the ambulance volunteer service is going out of business. We have a worse situation now than we had before. There are whole communities now that don't have any ambulance service. The idea behind the legislation was good but they didn't take into consideration these community subsystems and the way they were delivering the services. We also have some morticians who have supplied ambulance services and they are going out of this type of business, too.

CRITERIA FOR DETERMINING SYSTEM

Hardin: Let's look at a few criteria to see if we can develop some guidelines that might help us determine what we're willing to treat as a system. Now keep in mind that it is almost senseless to argue whether somebody has a system or not. You can argue that it may not be worthy of discussion, but you cannot argue that he doesn't have a system.

Closed Systems

Now an obvious example which some of the economists here should be familiar with, are closed or

deterministic systems. They physical science areas traditionally used closed systems in the analysis. Essentially this is a portion of the world which you isolate out at a given state. Given initial conditions of the state we can easily predict where the system is going to go, because we allow no inputs into the system. The end result of the system is two things: it can either reach an equilibrium point, or it will reach a maximum entropy. Entropy is probably most easily described as being a randomness of a system. Human beings reach entropy when they die. Disorganization is entropy. Either the system completely runs down or it's at an equilibrium point.

Equilibrium or Entropy

The reason this is true is due to the laws of nature that state as you have activity you use up energy. If you didn't make this assumption, which is the first law of thermodynamics, we could have perpetual motion machines. However, because we use up energy within closed systems when we don't have any inputs into the system, they are bound to run down. Now this type of assumption about the closed or deterministic system is very convenient to use because we can easily predetermine the end state.

Open Systems

When we get inputs into and outputs from the system, we call this an open system. So the system that we want to talk about should be open systems. That doesn't mean we can't talk about closed systems, especially when we're talking about human beings. But here, we're talking about systems that are going to get new inputs, and for most systems that we deal with, they are going to be open at both ends. Anything the system needs or uses that are new elements coming into the system are inputs (e.g., people, resources, money).

Inputs and Outputs

INTERNAL/EXTERNAL CONSTRAINTS

In contrast to the equilibrium states of the closed system, where can the open system go? Well, since it's really independent of its initial conditions when we see it, the end state can be anywhere. It does not have to go to an equilibrium or maximum entropy. The only thing that will help us determine where the system is going are the initial external constraints on the system. External constraints essentially are the things that are outside the system. In case of the health services area an external constraint might be government policy. Internal constraint would be the number of doctors or the number of hospitals. When is an external and internal constraint relevant?

Determining Internal and External Constraints

It helps you identify what connection a factor has with the system. Does it tie in with the system or is it outside of the system? Basically a good way of determining whether it's external or internal is what influence the system might have on it. So now we have inputs, outputs, external and internal constraints.

FEEDBACK MECHANISMS

Feedback As New Energy

You noticed in the open system here, we still lose energy. If we lose energy, assuming again the first law of thermodynamics, the system should run down. The thing that keeps the system going is what we refer to as feedback mechanisms. In other words, from the output of the system we get a filtering back in of information for instance, that says you are doing too much, or you are not doing enough - increase it here, stop it there and so on. So it's in a sense a feedback, and it can feed back in various ways. In the open system we have inputs, outputs, and a feedback mechanism. Because of the input of new energy, open systems are characterized by negentropy. I had an individual one time say it's impossible to have negative entropy. But the only thing I can say is that it is a term that is coined to say that instead of moving towards disorganization or death we are moving towards more complexity, greater information, greater certainty.

Negentropy

Constraints on Feedback Mechanisms

In other words, if your feedback mechanisms are not doing the job, you are not getting inputs and you are producing the wrong outputs. You could still end up dying. There are constraints on the system. For instance, we have pretty good feedback mechanisms in human bodies, but we all eventually die, mainly because there are some internal constraints on how long our cells live. Take societies as another example. Most societies grow to be more complex and sometimes it happens that they get so big that eventually there is nothing acting as a constraint on the system's feedback mechanisms. If you don't have another society to compete with you might say I'm not having a good enough feedback mechanism for what is wrong with my own society. Therefore societies may become stale.
Comment: Is this what happened to metropolitan areas?
Comment: It could be and also some rural communities.

PARAMETERS

Definition

Hardin: Instead of external constraints you will find in the literature sometimes the term, "parameters." What are the parameters of the system? Essentially the way I differentiate a parameter from an external constraint is that there is not too much

chance of the system ever really affecting the parameters. We may have some influence on external constraints. A parameter in this case would be that you are in the United States. It sets some things for your system. If you are in the eastern part of the United States that may be a parameter and you have to worry about this when you go to talk about the system and change the parameters to the southern states. Also, an external constraint for a subsystem may be an internal constraint for a larger system. It is important to know whether a variable is a constraint or not. For the convenience of discussion we talk about external and internal constraints, but as far as identifying or putting a label on a variable as to whether it is an external or internal, I think you are missing the point of why you are doing it. Whether a variable is an input or output, is for convenience in discussion, in defining your system. By saying, what are the inputs to my system; what are the feedback mechanisms coming into the system; what are the parameters around it; what are the external constraints and the internal constraints; you define those things to defining your system.

Defining the System

Comment: Well, maybe that's why I'm starting to worry about the dynamics? We are talking about constraints. Are the inputs and outputs the dynamics of systems analysis?

Comment: Is efficiency an internal constraint?

Comment: Or technology?

IDENTIFYING CONSTRAINTS

Hardin: Some technologies would be internal constraints. For instance in the health care area, external constraints might be the technology of the transportation system, because you are not including the transportation system into this concept of the system you are talking about. If you include the transportation system, and the road network as being a sybsystem, then technology is an internal constraint of the system. The important thing is that when you start identifying the inputs and the constraints on the system you try to categorize them? Is this really an internal constraint? Remember that the system can do something about internal constraints.

Categorize Inputs and Constraints

Individuals are in ernal constraints although they are continuously changing. Can we change the people in the system? Well, to a certain degree we may be able to and that degree may be the constraint. We may have an external constraint that says we can't change the people. It is identifying these that will help you identify the system; to help you learn what systems

Identifying Constraints in Defining the System

we can talk about. When you have identified the constraints and want to control or change the system and cannot change the constraints, then the alternative states that this system can be in are limited. For example, if you can't get a government policy changed, you've got to work within that constraint. The key here is identifying which are the important constraints of this system. Who determines which constraints are the most important? Again we go back to value judgments and being able to talk to people.

Value Judgment

Multi-Finality, Equal Finality

Let's talk about the end states of a system for a minute. In a systems approach there is an assumption called multi-finality and equal-finality. Equal-finality says that the end of the system, and by the end we mean simply the end of our time frame that we are talking about, can be reached in various ways under various conditions. For example, you want your corporation to make a $100 million a year. How many states or conditions can you go through to get there. Do you have to be Xerox to get to the end state? Can you be General Motors or some new firm coming up and get there? Or, if your goal is to have a good health services program and we've got three different beginning states, can we all get to the same place under different circumstances using different methods? How the desired goal is achieved may fluctuate from system to system. It says that we don't look for the one best method. Rather, we look for hypotheses that will suggest how to do the best job given a specific system.

PROCESSES IN SYSTEMS

Comment: I'm looking for correct terminology, let's take the health care system and the goal of good health. We've got our inputs which are the hospitals, the doctors, the paraprofessionals and so on. Now, let's assume we've got two ways to get there. One is the free market system, more or less the one that we use today, and the other would be socialized medicine. What is the correct terminology for the free market system versus socialized medicine?

Hardin: What you are talking about are two different processes. There might be various levels of combinations of this that could get us to the same point.

Comment: You would call free market a process, and socialized medicine a process?

Hardin: Yes. The way you are using it that is the way I think you are talking about this. You are saying that to you socialized medicine is a process, a way of getting health care to the people.

Comment: It is a way of delivery.

EFFECT OF INTERNAL CONSTRAINTS

Hardin: Right, and the important thing is determing whether it will or will not work doesn't necessarily depend on the process but on the process in terms of the constraints that it is faced with and in terms of what it is getting for inputs and so forth. For instance, socialized medicine may be the best way in Russia because of its system of constraints. It is internally accepted. whereas here people might not accept socialized medicine. There is an internal constraint against it. That's a value judgment.

Life Insurance Example

For example, if you know anything about insurance you will know that insurance was around for a long time. But it didn't sell because they called it death insurance. Nobody is going to bet they are going to die. And that is what you do when you buy life insurance. As an individual, you cannot win when you buy life insurance. When they called it "life insurance," this changed a very simple constraint. As you look at the insurance business today it has grown quite rapidly on the concept that all individuals are going to die.

CONSTANT CHANGE IN OPEN SYSTEMS

Inevitability of Change

There is an assumption that open systems are continually in a state of change. I am not using change in a sense that it is always for the betterment, or that it is always good to change. I think there is too much of that in the literature that states that change is always good. Open systems are continually changing because of the nature of the system itself. Over time a system must contend with other systems. As the open system tries to adjust to its environment, for instance adjusting to its feedback mechanisms and adjusting its relationships, it is going to affect some other subsystem or other systems in its environment. Thus, the system itself causes changes to occur in the environment and the systems it deals with. Also at the same time we are getting change in the internal subsystems. As one internal subsystem changes it will effect other subsystems.

Comment: You are saying the environment also feeds back to the system as it changes.

ULTRASTABILITY

Hardin: Right. Now we want to talk about stability. This question was raised a few minutes ago in other terms. This system is changing. I just told you it was changing. We are changing the constraints, inputs, outputs, and some of the feedback mechanisms. What makes that the same system? Well, we look at systems over time and a term which is used to describe systems over time is ultrastability. This defines

stability in terms of change. The system is constantly changing but it has a stable change. In other words, the system is at an equilbrium with its environment while the system is changing.

Stability of Whole System

So, the stability we think of in a system is a characteristic of the whole system rather than just the internal parts. A lot can be going on internally and yet the system is relatively stable. Now even though aspects of a system's structure change from time-to time it does not necessarily mean that the system dies, or is no loner the same system. For instance, if we are talking about the school board again, in a hundred years, assuming that we have the same number of slots for our school board, we still have the school board system. We may change every component of the system and we still have a system. So it doesn't say we are tied just to one set of components.

TAKING ACCOUNT OF CHANGE OVER TIME

A big key to estimating system stability is that you've got to make a determination of when or to what degree that change has occurred in the system such that it is really not the same system. Let's say we have a school board of which there are five members. We want to talk about a school board as a system. The school board elements or subsystems are individuals. Let us say an individual dies. When this individual dies we bring in individual A. We still have five individuals. The question is, is this the same school board? Is it the same system?

School Board Example

In systems we say we can change individual components of it. Over two years we could do the same for each individual. And we may still be able to talk about the system as the same system, and predict about the school board system as being the same. I would like to use as another example the body. Am I any different as a system if I took one of my fingers off? You would probably say, "No." What if I took my hand off? You probably are still willing to go along with me and say I haven't changed too much; I am still the same system. I could probably even cut an arm and a leg off. But if I go beyond that you might say wait a minute, too many things have occurred that have changed the system. Now I am no longer dealing with that type of system.

Physical Example

Comment: Yes, but your example here was removing members of the school board. Suppose that over a ten-year period because of voter sentiment the board changes completely in its membership, you still have a five member board but now its decisions are entirely different. Is this the same system or is this a new system?

Change in Attitude Structure

Comment: Once we studied attitudes of workers in particular departments every two years for twelve years. By the end of the period not one person was in the department that was there in year 1. Not one function that was performed in the department in year 1 was being performed in year 12. Yet the attitude structure did not change at all.

CHANGE IN INTERNAL CONSTRAINTS

Stability Due to External Constraints

Comment: On the other hand, you may have a situation where the school board may change in a very short time. What you have done here is change its internal constraints because school boards are legally defined entities, with certain proscriptions on their activities. The major functions that are performed by that board have not really changed. There are different atttitudes, different values, different sets of internal relationships. But, the major output has changed relatively little. Stability is not due to change in the internal constraints; it is because the external ones have not changed.

Hardin: So, would you then conclude that it is the same establishment?

Internally Changed; Externally Constrained

Comment: Well, this is the difficulty. It is the same system in terms of the classification of systems. But it is a different system if you are looking at it in terms of its internal dynamics. The system right now might vote at a local level to say, "Yes, we will let girls wear mini skirts in school," where the system a couple of years ago said, "No." But they can't say, "We don't like the way we are funded and we don't want to have to depend upon taxation at the local level; we want our funds to come some other way." They can't do that. It is the same system in terms of external constraints but it is a different system in terms of internal constraints.

CHANGE IN PROCESS WITHIN SYSTEMS

Decision-Making Processes

Comment: I would like to add an example to this, that deals with process though and not changes in the people only. The example is town councilmen or town supervisors in the Northeast. I think one trend that is taking place related to that system is their decision-making has been moving away from the concensus form of decision-making. This is where you decide what you are going to do before the meeting and that becomes the only business you bring up at the meeting. If you read their minutes it looks like there is a tremendous amount of agreement among the group. Now, I think there has been a movement,

though it is hard to document in this decision-making process, among boards of township supervisors, or councilmen or whatever, to a more debate-oriented process with split votes and this kind of thing.

Change in Perceived Role

Comment: But what is happening there is that at one time the school board or select men or town constables were defined as strictly an autonomous unit. We voted them in and it was their job to run the government. That's no longer their job. That's no longer their role in the eyes of their constituents.

Comment: You can change some of the external factors that are brought to bear on the same system with the same people in it. But for my purposes, I claim I am dealing with the same system that has the same status-roles, many of the formal expectations are the same, and yet the way that these expectations are filled or the roles are performed has shifted. The process has shifted as the result of change in external forces.

IDENTIFYING CHANGES IN THE SYSTEM

Internal Change, Process Change

Hardin: From a research standpoint a big factor is what major changes have occurred. Now notice our assumption that the sum of parts does not equal a whole allows us to change the elements internally, or change some of the processes without saying that we have lost our system. This is important because we know that changes are occurring over time. Now, if I am talking about the school board, what changes have occurred, major changes in either external constraints, internal constraints, inputs or outputs? Has the system changed so much that I can no longer go back to 1920 data or information about the school board then and say what happened there has some relevancy to the system I am talking about now?

The definition of these breaks depend on what you want to do with this system. Would you say the school board is still the same? Perhaps the decision-making process of it hasn't changed so far as the system goes. Maybe the structure has.

WHEN THE SYSTEM NO LONGER EXISTS

Legal Dissolution

Comment: During the consolidation of education in some of the states in the Northeast there were actually systems which were formally and legally dissolved. Supposedly they disappeared. We abolished the social position of town school board member. It no longer exists. That seems to me to be a major discontinuity in this stream of events.

Hardin: Take General Motors as an example since a lot of studies have been done on that corporation. If you try to go back to 1920 General Motors, you will find it was a lot different than it is today. If you go back to 1940 you will see some things have happened in the system. It might be nice to talk about General Motors of 1940 as a system and comment on that system, but it doesn't help us necessarily explain where its behavior is going to be today. So many things have happened somewhere along the line that it has changed. It is a new system.

The Past as an Indicator of the Future

Another example. We recognize separations in the human system. We speak of ourselves as children, as teen-agers, and then as adults. We say there is some insight we can gain about constraints if we know where a person has been in the past. But we would not say that on the basis of this information I can explain your behavior today. (Although there is a school of thought that says that I can explain your behavior by going back and seeing what your behavior was as a child.) This says that the system has changed so much and the constraints on the system have changed so much that it is not really relevant to the prediction of your behavior to go back that far. It may help explain what you might do, but I can't look back there and say because you did this or that or had that attitude that you still have it.

Discontinuity of the System

Comment: Certainly you can't control it.

ACCOUNTING FOR CHANGING SYSTEMS IN RESEARCH

Hardin: You can't control it. And this I think is important when you start looking at systems because some systems will change more. Within a year you may have four changes or more until it no longer is the same system. So you've got to try to deal with changes in systems. If you are doing a longer type of study you should use a technique that takes this into account. Legal changes could drastically change your system. Therefore, all the things that you said about the system in the past may not hold true today. Now the key, I think to doing research on a system over a time is to make sure that the people looking at the system say that it hasn't changed so much, or, that it is no longer the same system. Because when you try to go to predict about a system that was there ten years ago, it is not going to work.

LEVEL OF CHANGE

Comment: The degree of change relates to the mix between external and internal constraints. The selectmen, for instance, can change internally but with very little external change unless some higher order of system decrees a change. And I think this has to be taken into account when you are looking at change. What order, what level of changes, are you talking about? Does it come about as primarily internal or external changes; for instance, external change by fiat. A change by fiat would be to say instead of having a three-member board you are going to have a five-member board, or you will no longer have this jurisdiction or you have added jurisdiction. That is one level of change versus a change internally like for instance your attitudes, values and so forth in terms of the people.

Change by Fiat

Comment: This degree of internal and external control can be capsulized in the degree of autonomy of a system versus other systems. The external constrainst may be greater on one system than on another. In some cases the primary thing inhibiting change may be internal constraints; the external ones may not be a very big factor. Change may be harder if all the constraints are internal.

Ability to Change the System

OUTPUT AS CRITERIA OF PERFORMANCE

Hardin: Now I think by this time you probably have a feeling that our emphasis is not upon the output of the system. The important thing in understanding systems is the understanding of processes that go on. Output is part of it but not the crucial part. And when we make this assumption we ought to look at the output just to give us a criterion to judge how the processes are doing. In other words, the outputs are used as a criterion from which to judge the performance of a system. The essence of any system, however, can only be understood by understanding the processes that go on.

Most Important Factor

Now just to give you an example in the university area, we have University A, and University B. We judge the performance of a university by how many students it puts out. That is its output, how many students. But the essence of the university is not how many students it puts out, but the process it goes about in putting out the students. In other words, you can put out quantity but it may not be quality. So if you are looking at a university and you are trying to improve in the university system you are more concerned about what processes are going on to give you the output. It doesn't mean you don't consider the output as far as quantity is concerned but it is not necessarily the most important factor.

GOALS OF THE SYSTEM

In the industrial area the emphasis on profits has been overriding. This is getting a lot of firms into difficulty because they emphasize output rather than looking at the processes that are going on.

Specifying the Goal

This gets us into the question of what is the goal of the system? I am surprised that somebody hasn't raised that question today. We have been talking about systems. We've named a number of them. But, what is a goal of a system? A company is a good example to look at because there must be at least two libraries full of literature on the argument of what should the goal of the company be. The argument obviously is profit. The company should be profitable. That is simple, but what is profit? Profit for whom? You say the stockholders for one. But what about managers of the company? If they don't make a certain amount of profit they are not going to be around. Is profit for the short run or the long run? We all know that we can do things in the short run that will cost us money in the long run. So, when should we have profit? In what time span should the profit be made? Obviously if you are stockholders that only want to hold stock for six months you want the company to come out with fantastic profits quickly. Profits for whom? Do you want to have high profits for the government?

Multiple Purposes

Another person might come along and say the profit goal is bad. Companies should have some responsibility to the community. So not only does the company have a profit motive, but it has a service to the community goal as well. We can go on with various aspects of company goals. One would be responsibility to the people that work there. Unions argue that a firm should not be allowed to dissolve itself if it wants to. It has a responsibility to the workers to stay in business, whether it makes any money or not.

Purpose of Goal Definition

Now notice the problem you get into. What is defining the goal of the system going to do? It will tell you what the system is going to do. If you are going for profit then you can explain some of the behavior of the system. Now, can you think of one goal that all systems have?
Comment: System maintenance, existence.

SYSTEM MAINTENANCE AS A GOAL OF THE SYSTEM

Hardin : Okay, existence. We could define a system that didn't have that, but do we ever really want to talk about a system that does not want to be there? So if we define the primary goal of a system, of all systems, as existence, or we might say survival, we avoid arguments over what is a goal of that system. And, therefore, we avoid the argument of which is the best purpose for the system to do. By assuming that a system would not do anything that would jeopardize its survival we can then look at the system in terms of what it would do in attempting to maximize its potential survival in the future. What are the constraints with which it is faced?

Survival

For instance, a school system has to be effective. It has to be efficient. It has to be adequate. How do we determine how effective the school system has to be? It will be as effective as it has to be to guarantee that it will be around. Few systems want to dissolve themselves. For example, think of the federal government. I don't know of many agencies that have ever been dissolved. They just keep staying around. They may change their goals or constraints that they are working under but they still remain relatively the same systems.

SELF-PERPETUATING SYSTEMS

The March of Dimes is another example. The March of Dimes in time solved its problem didn't it? We thought we got rid of it finally. Then every year there was still a March of Dimes drive. When they finally conquered the disease they wanted to conquer, if that had been their goal, they should have said that was it. Let's quit. But what happened? They quickly shifted the constraint to say we have other diseases that we need to look at. Now when you are dealing with systems you assume this. You say no system is going to do anything that it thinks is going to jeopardize its existence. A system does not think, necessarily, but if can react to its environment. It will adjust in any way necessary to guarantee existence.

Changing Constraint

Reaction to Environment

So when you try to understand the behavior of what takes place within a system you say that anything that takes place has to be viewed in terms of balancing the influences of subsystems that are trying to stay around. Now all things being equal, the larger system will usually win. If the larger system sees that abolishing a subsystem would be good for the entire system, it will have to take

A System Will Not Self-Destruct

action on the subsystem. The subsystem will not dissolve itself.

FEASIBILITY OF SYSTEM CHANGE

Abolishing the subsystem or dissolving the larger system has to be feasible. I have taught a lot of case methods to students that want to find out how to improve a company. I am amazed by the number that would tell me to get rid of the president or the owner. How do you fire a president? How do you get rid of a person that owns 51 percent of their system? Therefore when you look to change the system you must be realistic about the alternative states that you can be in. In the federal government, for instance, when you create an agency, I would be willing to bet that it will be around as long as the government is around, in one form or another. If you want to create a subsystem you may be creating complexity without solving your problem.

TEMPORARY SYSTEMS

Comment: How are we to analyze what is increasingly a phenomenon of our time, the temporary systems? Some temporary systems are deliberately established to be temporary. The larger system sets up a temporary subsystem whose output will supposedly enhance the larger system, that is, enhance the survival of the larger system. But the subsystem is deliberately created in such a way that survival is not its primary goal. Its primary goal is another kind of output. It is a deliberate attempt to structure things so that this survival goal is subordinated and that you get an output, a specific kind of output.

Created Not to Survive

Comment: Most of the time we are talking about systems which are created to perform action or to bear responsibility. An end product is some type of action. Ad hoc committees don't usually fill this role. They have no responsibilities, they have no decision-making power for the most part. They are advisory only, or fact finding only and the responsibility and decision still rests within the primary system.

Action Versus Advisory Roles

SUBGROUPS AS INPUTS TO THE SYSTEM

Hardin: You could look at it from an input standpoint, too. We can't think of inputs necessarily as just money. Obviously if you had an ad hoc committee and you have given it certain funds and the funds run out it is going to dissolve. It has no more input. If you bring people into committees and don't pay them you are giving them what else instead?

Restricting Inputs

What are the inputs you are bringing in? Well to entice them to come in you may be giving them prestige and so forth. Then you say no longer are you going to be called a member of this committee after this certain date because we don't want you any more. In other words, again you cut off the input of the system. We are talking about a larger system that is creating a subsystem but holding it very tightly within bounds and holding very tight controls on the inputs and outputs.

DISSOLVING AD HOC GROUPS

Balance of Task and Maintenance Inputs

Comment: Some administrators have found that these ad hoc groups assumed a whole new structure of their own and got out of hand. And I wonder if in this context adding to it some of the things we know about systems there has to be some balance between orientation to a task and maintenance inputs? If you assign too big a task to one of these ad hoc groups pretty soon it is going to start calling in its own inputs that the larger system hadn't planned on. It will start building up its own processes and become institutionalized and you can't make the damn thing go away.

Comment: Educational advisory committees are a good illustration at the local level. They are made up of citizens and, if they can't get the board to act, frequently they will go out and campaign among the citizens on their own, and circumvent the board of education.

Comment: Also, they usually find a function all of their own, or a repetitive function. If it is a repetitive function you are going to be in trouble trying to eliminate them.

TIME SPAN IN GOAL DEFINITION

Survival Within a Time Frame

Comment: Our conceptual problem might be partly resolved in the definition of goal. The goal is defined within a time span. The so-called temporary committee has a goal and part of its goal is also part of the time span. Their goal is to do something within a certain amount of time. When that is done they no longer have that goal and therefore they no longer exist as a system. Yet, while they existed, their goal or need was to exist and survive. The same thing is true with this temporary committee that converted itself into a permanent thing. The goal is existence and survival of a certain time span. When that goal is met they may decide to change their goal again to survive for a new time span. I think these still fit within what Dr. Hardin is saying about the survival goal of systems.

GOAL ACHIEVEMENT VERSUS SYSTEM TENURE

Anticipated Output

Comment: Dave, I want to ask a question now. I think what I heard you say is that we anticipate a certain kind of output from a system. We really don't want to study, or define elements out there as systems if their relationships are so ephemeral that there is not a chance in the world that we could ever get that kind of output. We want enough stability in what we define as systems so that there is a chance that we can get the kind of output that we are interested in. I

Time Span Related to Stability and Output

am trying to relate time span with regard to system stability and possibility of output. With certain kinds of outputs we want to focus on systems that have a short calendar state. Yet there are other kinds of things, action or decision-making, we want to focus on. We want to define our systems predominantly for research purposes as those that have a long time span.

CONCEPTUALIZING THE SYSTEM

Hardin: One of the biggest problems in doing research on systems is that we have a tough time conceptually seeing them. We can agree on a car because most of us can see it physically as a system. We talk about what is the health care system and you start talking about different components and cutting across states. It is difficult to get people to agree that this is in fact a system that has a certain level of survival, that wants to exist as a system.

Non-Physical Systems

Comment: What if I invent a system and some how foist it on the public?

Different Perspective

Hardin: I won't use the term "inventing" a system because essentially their system is invented too. All you are doing is giving them a different point of view. In other words, you are going to have to say their concept of the rural community services system is incorrect. And that they've got to include these other elements.

Modifications of System

Comment: Do you think all systems in that sense are modifications and not a case of knocking this one out and inventing a new one; I mean, in terms of health delivery system?

Judgments on Elements to be Included

Hardin: Right. You know that the big problem in most systems of agreement is not on the obvious things; doctors, for instance, belong to the health system. Most people wouldn't disagree on that but when we talk about druggists we may have some disagreement. Are they in or out? What about the local persons in the community called midwives? Are these people in the community part of the health service area? You see that is cutting across judgments of whether we

should include the peripheral types of things, things that aren't obviously in the system. You are essentially expanding your system to basically a higher level. Thus, you are saying we cannot understand the health service area unless we include these elements.

System Not "Out There"

Comment: Do we need to go back to the basic but erroneous assumption (I always catch myself getting caught up in this, too) of thinking that a system is out there as a real thing. We agreed that we could, from an analytical and research point of view, define the system any way we want. But yet we are so culture bound in the theory of the firm or the organization that when we think of a system we almost think of it synonymously as an organization. That is why we try to say we invent a system. But, for our purposes, we don't have to be concerned with that because if what we are looking at doesn't meet our criteria, we simply define it in terms of new criteria. We don't have to worry about what is going on in the so-called real world or the phenomena as we see it.

System Not Synonymous With Organization

PURPOSES OF DEFINING A SYSTEM

Prediction or Control

Hardin : But we have to go back to what is the purpose we have in mind of doing the research or understanding the system. The purpose is either to predict where the system as we define it is going to go or to be able to change it and control it. That is where the burden of proof comes in. That is where we have to defend which level is the right level to look at the system.

System Level Important

For instance, if you observe that people are losing health services and someone else comes along and says, "But, if you look at this, they are not losing the services, they are just being misdirected," you may want to change things or your observation may be wrong. But, if you look at a larger system, you may be right. What system is worthy of investigation depends upon this. Obviously from the human standpoint we want to try to deal with the simplest system.

SYSTEM PREDICTION AND CONTROL

Research Goals

Comment: How do one's research goals fit into this? We can be interested solely in prediction, that is the extension of boundaries of our discipline.

Project Orientation

On the other hand our research project, in general, and many of us who are in the colleges of Agriculture, Life Sciences, Human Ecology and Human Development have a very strong mission orientation toward rural development. Given this kind of orientation we have an academic interest in prediction

and a very strong professional interest in control. In other words, we want to be involved in setting policy. If FHA changed the policy here, then what would happen? Now doesn't this tell us certain systems, certain kinds of consensus over system boundaries in action systems, in other existing governmental or private sector systems, have to be accommodated in our research design?

Accomodations in Research Design

THE "REAL WORLD" IN BALANCING THE SYSTEMS MODEL

Comment: We wish to work toward the future. We included as one of our research objectives, "now and in the future." We want to be able to think about simulated systems, one system, that our clients, the consumers, haven't even thought of. We've got to do some of that, but we've got to do some things that fit within the understanding of our action-related, legitimizing people of what systems are.

Simulated Systems

In other words, somehow we've got to find a rather delicate balance between "invented" systems and what I would like to call "simulated" systems; on the one hand defining systems as we see them and on the other hand staying within this balance of concensus as to what the real world systems "are." Because those people out there have to define systems and impose them upon the world, we may have to work within those systems as we do our research.

Balancing the Theoretical and the Real

RESEARCH SYSTEMS CONSTRAINTS

Hardin: Yes. You are talking about a research system basically. In other words you have to worry about your inputs to support your research. If you go out and drastically change the system or if you say there has to be welfare or free medical care for everybody, we know what is going to happen to the politician who funds or helps give you the inputs. If he is a conservative, he won't like that concept. Furthermore he is not going to stay in office because he helped fund you. You are not going to have your inputs very long. So what you are faced with is constraints on your research system. You can only go so far to change the system because of constraints on your inputs.

Input Constraint

You also have constraints on your output because you can't go too fast on the change sometimes, although you may know it may be good. The outputs will affect the constraints on the politician who gives you the input. So when you do the research, the alternatives that you can choose as far as changing the system is

Ouput Constraint

concerned are constrained; you can not do certain things, depending on the short run, or long run.

RELEVANT AND POSSIBLE RESEARCH

Research Constraint

The type of research or the system you talk about also may be constrained. You've got to make a judgment. How much constraint by the outside system is so much that you're really just wasting your time trying to get information about it. For instance if you are talking about changing an education system, a constraint could be that the only way you can make changes to increase the effectiveness, efficiency and so forth is to act on the total system on the state level. And there is no way you can do that. Then you've got to say, "Should I look at the subsytem?"

So you see, you are yourself caught in a system. In other words, when you start doing research you are bound. The systems that you can look at the outside people will try to define for you. And you in turn only have a certain variance within which you can even define systems. And unfortunately some of the best systems to look at are the ones on the outside of that variance. Some of them are eliminated because they won't give you information. You are cut off as far as gathering data on that type of system. So you are yourself dealing with a system.

RE-EXAMINING NE-77 CRITERIA FOR SYSTEM BOUNDARY DEFINITION

Hardin: How have you defined your system? We have down these criteria:

1. Nonmetropolitan
2. Geographic territory
3. Demographic characteristics

Comment: We are interested in people living in nonmetropolitan communities. We are interested in them in terms of the service they may get, their service at the local community. Or, sometimes they may have to go outside the nonmetropolitan community to get it. For example, some people may go to their regional medical center like Boston where there are eye, ear, nose and throat specialists and so on.

Services to Rural Residents

Hardin: Well how many of you agree that you are defining a nonmetropolitan area as people living in rural areas?

Comment: Well, we don't want to get hung up on the difference between nonmetropolitan and rural but if you can reconcile the two of them you are alright.

RESIDENCE AS A USEFUL DISTINCTION

Comment: In picking up your use of the word, "living," we have taken residence basically as the element of definition of the people in the system. Here are those people whose normal abode is in this region.

Problems of Residence Definition

Comment: Getting back to health delivery system and the problems that rural areas are facing now, it might be that they have a super highway. When interstate 80 went through northern Pennsylvania it created all kinds of problems in emergency care, because people were in the area who were never there before. They had to reshuffle this organization in the emergency health care area. With the health problem it may be that an area has to be defined as the geographic system rather than just people that live there.

COMPLEXITIES OF BOUNDARY DEFINITION

Limitations of Definition

Hardin : Do you see what I am getting at? If you limit your total system or your concept of what you are going to cover in services to just people living there you are taking it down one step. You have excluded a system which recognizes that transient people coming through the system may also need the services.

Distinction Between Permanent and Temporary Residence

Comment: This is a very real distinction. For example, the area that we are in right now as well as the whole state of Vermont is nonmetropolitan, but in the summertime two-thirds of the people in this immediate area come from metropolitan areas. Now, if we are concerned with service delivery in this area, it isn't where the people live permanently that is important. Rather, it is the services available in the area where they happen to be and for this part of Vermont the kind of problems they create because they are here. Now if you call living, temporary living or seasonal living, alright, then you have met your definition. But this boundary thing is more difficult, more complex than if first appears.

AGREEING ON THE TOTAL SYSTEM

Problems of Coordination

Hardin : Initial boundary definition is one of the problems as you start research. You are going down into the subsystems because this is what you are concerned with. You work with the larger subsystems. This is what you are going to be judging your work on. But, unless at the start you understand

what large system you all want to study, you are going to have tremendous difficulty bringing it back together.

Assessing Adequacy of Output

You are going to be judging the total services as the output. The way you would probably set it up is to examine the adequacy of the services, or community services for the large system. Unless you have a clear idea of what the large system is you are not going to know whether it is adequate or not. For example, it may be adequate for the people living there but not for transient people.

Now, from a practical standpoint, if you are going to try to get funds or to convince people to change and you leave out a big segment of the population you will make it more difficult to sell your change to people. You may not get funds from the government because they recognize there is a big element you possibly have left out as far as effectiveness is concerned. The general public may not even recognize the fact of effectiveness in your system because they are judging effectiveness by when they go into the state for a weekend. They are transient. They can't get health services on the weekend. They will call that ineffective. It may be highly effective for the large system you were talking about. We can't even start talking about spliting up into subsystems until we agree from a research standpoint on what are we going to consider as our large, main system.

TOTAL SERVICE PROCESS

Focus of Research

Comment: If one studies service delivery systems does one include the consumers of the system, or solely the providers?

Hardin: Well, that's why you are dealing with subsystems. I think you've got to take the larger view of all the services. Now how do you go about measuring the subsystems and the processes that are going on? You can't determine that until you say what is the larger system you are going to look at. You've got a giver and a receiver. If you look only at the providers then you are saying research-wise we are not concerned about the receiver. We are talking about services only up to the point in time until they can be received. That is a couple of levels down from the total system.

RATIONALE FOR DATA COLLECTION

For example, I noticed you have some demographic figures, right? But before you did that research what

Convenience

determined the group that you looked at. It appears that you took actually the people that were living here. Which was what? Convenient?

Comment: Probably.

Hardin: Convenient because of permanent residence.

Inclusiveness

Yet if that is the system you want to talk about because of convenience, stay with it. But if you want to include transient people and we want to concern ourselves with delivery systems of health services, we are going to run into problems because we have excluded in this area of Vermont at least half of the people to whom we are supposed to be delivering services.

MAXIMIZING EFFICIENCY UNDER CHANGING NEEDS

Peak Needs

Comment: This is one thing we kicked around earlier. One of the problems was in delivering this service in terms of the peak need and whether you have under-utilized services when your seasonal residents aren't in the community. Meeting the peak needs of the seasonal people creates quite a drain on services for the year-round community. You may be over-built in terms of hospitals. Whereas for the year-round residents you may be under-built in terms of educational facilities.

Off-Season Service Drain

Comment: Are all the outputs of any system either inputs into another system or feedback into that same system?

Hardin: Right, output has to go somewhere. By definition of the way we are looking at the model, any output has got to affect some other system.

Under Utilized Facilities

Comment: So if you are over built in terms of your peak needs for this community, then that is not necessarily efficient because it is not being utilized year-round. Say you have 100 hospital beds and you need that for the skiing season, because of broken legs, arms and so on. Then in the off season of the year you only need 20 beds. What you have is 80 beds that aren't really helpful.

Meeting Peak Needs Without Over-Loading System

Comment: An 80 bed constraint, right? You've got to decide whether you can afford to operate and survive.

DEVELOPING FLEXIBLE SERVICE RESPONSE

Comment: I was making an assumption that if you were going to be functioning as a system you had to meet that peak demand for 100 beds, even though in parts of the year you only needed 20 beds.

Comment: Then you've got to ask how can we meet the peak without being disadvantaged with the

overwhelming 80 bed constraint because that influences the effectiveness or efficiency of our system. And, therefore, our output is going to be very costly in terms of resources.

Comment: Well, it would be nice to have 100 beds available for people who come here for a short period of time, but the permanent system just cannot take that load. We need an innovation in how to meet that need.

DEFINING THE TOTAL SYSTEM AND RELEVANT SUBSYSTEMS

Definition of "Resident" by Subsystem

Hardin: Here we have a problem of defining the people that are living there and transient people. Let's assume that certain researchers only want to look at the permanent residents. Maybe certain other individuals only want to look at the transient people. When you gather information and you say, "I am only talking now about the residents," you know what subsystem you are talking about. In the educational area you may find that it is more logical and meaningful to talk about just the people living there because the transient people aren't going to be going to the schools.

Specification of System Level

In the hospital area you may find that you need to talk about the larger system in the sense of including both of them. You are talking about meaningful ways to express effectiveness of the subsystems. Any statement must be prefaced by the the fact that it refers to a specific system level.

Constraints in System Definition

In the education subsystem you are holding the external constraints, i.e., the transient people, fairly well constant, and concluding these constraints are not going to have a great effect on the educational subsystem. So, when someone in education says," This is an effective service in our community," we know that this system includes only people living there and not transient people.

But, when you talk about hospital effectiveness you are talking about effectiveness for transients as well as more permanent residents. The housing analysis you may split up into residential services and transient services. You may decide that there are housing services that this area must have for people that are transient. You may do effectiveness studies of transient housing and essentially not worry about permanent residents except as a constraint. Now, when you report your research, you know that it is based on the transient subsystem and it must be combined with findings from the residential subsystem if you are going to talk about housing services for the total population.

Problems of System Definition Recapped

One of the biggest problems of system definition is making clear in your mind before you begin the research what total system you are going to be talking about in your research. Decide who else is talking about the system and what are they talking about? When they read something about your work they will know what large system you are dealing with.

WHAT ARE THE LARGER SYSTEMS?

System as Mental Abstraction

Comment: What we have sort of tossed around is a new concept for me; that systems exist more in people's minds than they do as real objects. And therefore, for us to analyze health, housing and education puts us into a behavioral science kind of model of research. I don't know how much we have been thinking about that kind of model. It is a matter of tracing through people's minds talking about system as a research approach, versus trying to put down secondary data, numbers and such.

System Reference

Now when you take the concept of systems research, i.e., what is in people's minds, and add to that the notion that anyone of these three service systems is a part of a larger system, my question is, "What kind of a larger system are these subparts of? Is it the community? Is it the county? Is it the state?"

DEALING WITH ABSTRACTION

Hardin: Let's take the question about systems within systems. For me, all systems are basically abstract. Even a perception of what is solid can vary with individuals, but it is easier to understand something if it can be seen physically out there. Let's go to the housing subsystem.

A HOUSING SYSTEM EXAMPLE

State Level Housing System

We know that housing is part of a larger system. We know that there are constraints in the region, for instance, funding for the region. The funding is for the larger services system and not necessarily just for housing alone. Let's say that we are only concerned with the housing subsystem in one state. We can make an analysis of the housing situation, and possibly the adequacy and effectiveness of the subsystem within a state.

Regional Level

In our research we may conclude that the housing supply is adequate given that we are talking about this subsystem. The supply may not be optimal if we combined it with the other ten states. In other words,

optimal housing for the region may be slightly different; it doesn't have to coincide with optimal housing for a state.

IMPACT OF SUBSYSTEM ON LARGER SYSTEM

Relevant Constraints

Further, what this system does will have an influence upon the larger system that it is in. If all the money is given to one state what's going to happen in the other ten states? Also we are concerned only with the constraints on the system that are relevant. We have a multitude of constraints, obviously. We look for relevant external constraints which originate in the larger system that the subsystem is in. It would be almost impossible to constantly keep going up system levels.

Now you can take it down even a little further, and go to the individual in a particular community.

Individual Level

What is optimal housing for an individual, given certain constraints? For example, one constraint is that he won't move away from a certain location. If we could get the individual to move we might be able to get an optimal housing situation more easily throughout the state.

So we can deal with the subsystem recognizing that the larger system has an influence on it. Characteristics of the larger system serve as constraints. Also, we can talk about the subsystem and its influence on the larger system.

ABSTRACTING THE SYSTEM FROM OBSERVATIONS

Now to answer the question about the abstraction of the system. The systems approach says that we see objects, e.g., individuals and houses, and the interaction among these objects. From these observations we have to abstract the processes that go on. These compose the system.

Observing Interaction

It is important to note the interaction among objects, e.g., individuals and houses. This does not imply that it is necessary to ask each individual about his conception of a good house. We look at the housing that they are choosing and conclude that since most people tend to be choosing this type of housing, they probably prefer it.

PREDICTING WITH A SYSTEMS MODEL

Building the Model

If our model predicts correctly, we build this certain type of house and people live in them. Therefore, the system or our concept of what is out there as a system, gives us a good predictive tool. We don't know that the system model is correct. There could be other reasons that are the cause. Our model says that it was the preference of individuals to choose this type of housing that caused them to live in the houses. It may be that these houses are the only ones available. But the model or the system we are talking about helps us predict.

IMPROVING THE MODEL

Adding New Relationships

If we are wrong and the people don't live in the houses then we have to go back to the model we created and ask ourselves some questions. Is our error due to focusing on the wrong process? Is there something else that we need to include in the system that helps us explain the situation? Could it be that not only the appearance of the house but the number of the apartments that are available for rent should also be included in the system?

We posit another relationship. Maybe there is a connection between the type of house and the availability of rental units. There may be an interaction between those in a person's mind. We predict on that basis and build rental housing to provide better services. If we predict that they would go into the rental housing but they won't go into the regular housing then we predicted correctly.

BUILDING A SIMULATION

Model Stage I

What we are starting to do here is to build up a simulation. I start off attempting to make the assumptions that I believe will hold true as simply as possible, as linear as possible and without any interaction. That is the easiest model with which to deal.

Model Stage II

But due to the fact that there are interactions among variables we need to have feedback here. At any point in the simulation's development we may try it to see if it predicts where the system is going to go. If it is accurate we are more willing to accept the simulated system model.

Trial Run

If I change one of the assumptions here, for instance, and put in a higher proportion of rental units, what will be the effect upon housing adequacy? You change the variable in the simulation and run it through to see what the system would then look like.

IMPROVING THE SIMULATION

Model Stage III

If you get good results from the simulation, you may want to build more rental units in your community or state. If you do this in your community and rentals don't come out the way you thought they would or within bounds you anticipated you've got to go back and ask yourself," Why?" Was it because you didn't use the correct values in this system? Or, was it because some external constraint came in that you had not considered, e.g., a flood? If you don't think an external constraint has drastically changed the situation, go back to your simulation. Ask yourself if there are some relationships that are incorrect. Then, you change them to better predict the situation you observed.

DYNAMIC SYSTEM

Relationships

What you have done by using a simulation is create a system that is dynamic. There are certain relationships and you are taking them and building a model. And, over time, I hope to build it complex enough so that as I understand the complexity of my simulation I will understand the complexity of the relationships in the real world.

Imperfect Image of Universe

Remember one of the first comments I made. We don't expect any type of simulation ever to be exactly like the universe. But our simulated system helps us understand what possibly could happen if we do such and such. If we change the income of the people, what possibly could happen? If we change the tax rates, what possibly could happen?

INTEGRATING SUBSYSTEMS

Comment: Earlier you commented that in order to integrate the findings of research on three subsystems you had to have some sense of the definition of the total system. Though that intuitively is attrative to me I haven't the foggiest idea of what it means.

Integration Defined

Hardin: You have three subsystems and you want to integrate them. This is not in the sense of being able to use the same data. What I mean by integration is that if we are talking about a concept of services and our concern is with the total service delivery system,

in order to improve the total delivery system we've got to integrate what is going on in three subsystems.

Integrating Housing and Education

Take housing and education as an example. You are interested in providing schools closer to chidren's homes because you think that will improve the school systems. Therefore, where should you put your new schools? If you make this decision without also including the housing system you could be placing schools where there is no housing. Or, if you start with housing, you may put housing in a place which creates educational problems.

Maintaining Common Level of Analysis

Now, if you are going to do research in community services you've got to keep this in mind. What you want to do when you are investigating one subsystem is to keep it close to the other subsystems. The researcher may be gathering information and building understanding of the education system, which is an external constraint upon the housing system that you are studying. And, the housing system, in turn, becomes an external constraint on the education system. We can better understand the housing subsystem if we know what is going on with the external constraint represented by the educational subsystem.

Interrelationships of Subsystems

Without going into detail you can see how this would effect hospitals as well. If your schools and housing are in a certain place this location is going to affect your medical area. Where do we put the medical facilities? Now if you go about this using a nonsystemic approach you would put in the housing and then worry about the education facilities later.

OPTIMIZING THE TOTAL SERVICE AREA

Suboptimizing Subsystems

In a systems approach we are looking at a total area. We would like to put our housing, education and hospital services systems such that the location of all three of them is optimal. You may do one in a isolated fashion or maybe you would want to have an optimal school system but you can't get as far with the other two, housing or medical services. Then you optimize the total service area. In this case, it is a matter of where you would put your physical facilities. You are sub-optimizing the individual subsystems.

CASE STUDY AS INTEGRATION TECHNIQUE

A technique of integration that has not been widely used in some areas is the case study method. Perhaps you might try to find a typical county area.

You may want to go in and just concentrate on getting information about all three service areas and how they interrelate there. Then you could come back and discuss the influence of one on the others. From the case you might see how the system could be integrated.

LEVELS OF ABSTRACTION

Advantages of Community Level

Comment: As you have been talking it increasingly seems to me that a system is an abstraction and that even as an abstraction "community" is a useful way to think about a system. In other words the most practical level of analysis is not this region, not the state, but it may be a community. At least at that level of abstraction you have all three services and you have identifiable constraints in terms of willingness and ability to tie these three services together. You have identifiable external constraints in terms of state and federal policies as they affect local services. As an abstraction, the community might be a useful way to think about the system.

Choose Level with Best Results

Hardin: You have to keep in mind that the systems approach is only concerned with being able to predict the phenomena we are going to see in the future or being able to control or change the phenomena. So, we are not too concerned with the level of abstraction. In fact, we use a level of abstraction that gives us the best results. If looking at the total services of a region does not give you the best results from the standpoint of getting the things done, you may have to go down a step. If you are uncomfortable dealing with the high abstraction maybe you've got to come down to a lower level.

COMMUNICATING ON THE SAME LEVEL

Commonality the Key

The key here is that the level of abstraction you select has got to give you an increased understanding or increased ability to predict or change the system. The point is not to get hung up on which system you have to be in. Remember that the key is that if I want to talk to you about this system at this level, I must make sure we know what we are talking about. If you want to talk about community systems, many people will have a feel for this level.

Federal Government Example

I think we ran into this problem of system levels in some of the government programs of recent years. That is, we may be able to sub-optimize systems, but from a total standpoint it has been detrimental in some areas. The way that welfare standards are set is an

example. Spreading the welfare burden by allowing states to have the ability to determine how much they want to give may put unjust burdens on some states. State-determined welfare benefits may not be optimal for the total system while for some states it is optimal.

Unconscious Community Focus

Comment: I think we have been thinking about primary educational, health and housing services that most of the people get within the community boundaries most of the time. Because that is almost the way we have ended up defining things. We talk about education as public, elementary, and secondary where we are typically within the community setting. In health care, although our focus is on all health services, our emergency health care services and health manpower are focused very heavily within the community setting.

MAINTAINING THE LEVEL OF ANALYSIS

Shift in Level

Hardin : It is very important if you are doing research on a system at the community level that you realize that is the level you are talking about. A year later you may try to talk about a service that you are now dealing with but try to talk about it on a state level. It is very easy to shift the level of analysis without knowing it. This shift could create tremendous confusion as far as being able to judge whether you are improving the system. That is, if you talk about the community, you can't go to the state level to make the judgment of having improved it. Stay with the community level and make the judgment there.

WORKING THROUGH A SAMPLE SUBSYSTEM - HOUSING

50 Percent Rental Housing

Comment: This subsystem model is confined to housing within a rural town. Let us assume that we can somehow locate a town with 40 or 50 percent of its housing being rental housing.

IDENTIFYING THE CONSTRAINTS

Larger System Identified

Hardin : What we have identified is a larger system that is the housing system. Since you cannot research the whole area right away, let's start with part of it. Maybe we can learn a little bit about that and it will help us expand. You are going to be dealing with the subsystem of rental housing in a Vermont town.

Location

A constraint upon this subsystem is Vermont and whatever that represents. Are people in Vermont any different than people in New York Pennsylvania and so forth? That automatically becomes an external constraint.

Comment: The other constraint would be that it is a particular small town. This is where it could be applied.

Size

Hardin : There are constraints possibly tied in with being a small town. Now notice we don't have to go into detail, it just means we have to be aware that there could be constraints on this system due to this fact. If there are, we will want to try to identify the crucial ones later.

Proportion of Rental Housing

Comment: Didn't we identify another constraint when we said the community would have a higher proportion of rental housing?

Income Distribution

Comment: Another external constraint may be that we are able to specify the income distribution of households who are in this rental housing.

DISTINGUISHING EXTERNAL FROM INTERNAL CONSTRAINTS

Hardin : Now, we are eliminating dealing with any subsystem that we cannot specify the incomes for. And notice that, in this case, once we learn anything from the subsystem, we can ask, "Would this relationship tend to hold true even though we can't specify the income distribution?"

Comment: I think this is an internal constraint of a subsystem.

Comment: No, it is an external constraint.

Hardin : Well, let's stop to think about it. If you have the subsystem and its physical area, an internal constraint is going to be the income distribution in that area. It is internal to the system. The income distribution is part of the system. It is not something like the influence of a state or the political climate on the area.

Income Distribution As Internal to the System

Land Use and Availability

Comment: Then, there is land availability in the small town and present possible land usage for rental housing.

Hardin : Then that is obviously an internal constraint.

Zoning as External

Comment: Might it not be an external constraint of land availability as well, depending upon zoning ordinances or state requirements as to where you can build and where you cannot build?

Hardin : Yes. However, probably our largest concern would be that the rental housing subsystem has an internal constraint. Admittedly, it may have some external constraints that influence land availability.

Comment: Well, by the way land availability is handled in the model we assume it directly feeds into the level of cost of land.

Factors Influencing System

Hardin : Notice, we are trying to identify key factors that are going to be influencing the system. Now, by putting land availability as internal or external is really irrelevant. What's important is what the constraints are going to be.

OPPORTUNITY COSTS AS A FACTOR IN A RENTAL HOUSING SUBSYSTEM

Rate of Return to Capital

Comment: Oh, then another constraint would be rate of return to capital in all areas other than rental housing in the smaller towns, which I am assuming is constant. This is the opportunity cost for the capital.

Hardin : The rate of return to the other housing is constant. Now, that is an abstraction if I have ever seen one. Why not start out and assume it is constant. We know that the variation is within

certain limits; but, to start our understanding, we will hold the rate of return constant for a while. It is important to recognize we made that assumption.

FACTORS IN PROFIT-MAXIMIZING BEHAVIOR

Supply Function

Comment: Then, the supply function for production of housing is a known function of the quantity of housing which is produced during the intervening time. For example, is you produce twice as many units per year you would have to draw resources out of constructing other facilities and you would assume rationality in profit-maximizing behavior.

Landlord Choice

The landlord has a decision to make which will affect the annual produciton of housing. He has the basic decision of how much housing will be added to the community each year; how much rental housing will be constructed?

Hardin : Did you say the landlord is an aggregate or an individual?

Comment: Well, at this point, the landlords are an aggregate.

Hardin : Are we talking about an aggregate decision of how much rental housing to bring in over a period? The period of time being a year?

Trial Run Assumption of Population Stability.

Comment: That's right, and in the first trial run of the simulation the community is assumed to have a stable population. So the annual increase in rental housing will be equal to the amount of housing that is being condemned or destroyed because it hasn't been maintained.

Comment: The weakness of this provision is that Vermont never destroys a house.

Destruction Rate

Comment: Anyhow, we assume the rate at which houses are destroyed is the function of a landlord decision which is an output of profit-maximizing. That is, the destruction rate is equal to a function of their maintenance expenditures on existing houses, by age and quality of housing.

CONSUMER PREFERENCES

Assume Households are Rational

Ordering of Preferences

Further households are rational; how they set up preferences for housing, other goods and quality of housing is rational. In other words, if they could get more quality housing, they would take it. Also, we assume an ordering of perferences for the quality of household facilities which they buy or rent.

Comment: What was the purpose of assuming an ordering of preferences.

QUALITY VS. QUANTITY IN HOUSING PREFERENCES

Comment: Two things, how much housing you are going to buy and what quality of housing are you going to buy. This is from the context of the total market because poorer households, given a reasonable set of preference functions, cannot compete as effectively as richer households for new and higher quality of housing. The next assumption is that householders, when they negotiate with the landlord, are going to negotiate only on the quality of housing. They go to a particular landlord who has a reputation for given conditions of households, either it is good or bad quality. They don't go to the landlord and haggle over the amount of maintenance. Maintenance is completely in his realm and separate from the housing selection decision.

Negotiate or Quality

The net result when you work with some of these functions is that you find that households are satiated more quickly with quantity of housing than they are with the quality of housing. Rich households will get all the better quality housing. Poor households will get the housing of inferior quality.

MODEL OUTPUT

Comment: What is the output of the model?

Comment: One of the outputs is the quantity and quality of housing at which each household of given income level will take the housing. Further, in our small town, given this model, the output is that people with high income tend to purchase new rental housing of a high quality and larger quantity.

Demonstrating the Obvious

Comment: Are we only demonstrating the obvious fact that people who have more money will get a better apartment? I thought we were saying something more. For example, I thought we were trying to predict the probability that household income would be diverted into housing in this case, rather than into some other good.

Diverted Investment

Comment: That comes later in the model. The fact that we come to a result which is obvious in itself doesn't make the model suspect. If it were contrary to our expectations at that point we would throw out the model. So let's not get upset with that. Have we already stated as an output the quantity of housing that is produced each year?

Hardin : Well, according to your model, you are saying that the aggregate decisions of the individuals is going to be such that they will build rental housing only to the extent that we have destruction of old housing?

Comment: That's right. Then, I postulate a function that relates the destruction of old housing to maintenance expenditures.

MAINTENANCE EXPENDITURES AND PROFIT-MAXIMIZING BEHAVIOR

Function of Profit Maximizing Behavior

I didn't mention it before but maintenance expenditures are a function of profit maximizing behavior of the landlord. The landlord is trying to get the maximum return on his investment. So, he is going to discount net income flows for his property over time, The net income flow will be a function of price per year that he receives which turns out to be a declining function. Let's restate our assumption. The landlord has to make a tradeoff between maintaining his structure, which will keep the price function at a higher level over time, and not maintaining the structure. If he maintains the structure the price function will be a higher level over time. But at the same point each period he will be losing his maintenance expenditures. So, if he puts too much into maintenance he will have a lower rate of return for his structure.

Declining Function

Tradeoff

Effect of Zoning

Hardin : How does zoning affect his costs?
Comment: Zoning would affect the lease cost of land.
Hardin : Could you manipulate income and property taxes?

Building Codes

Comment: Yes, and in addition you could manipulate building codes. Also, building inspections would probably effect the construction of houses.

PRAGMATIC USE OF THE MODEL AND EFFECTIVE COMPLEXITY

Changing Constraints

Hardin: Let me comment on the use of the model. Could you spend your time more effectively by changing one of the constraints? Typically, what you do with a model is change one of the internal constraints holding everything else constant. And you will get a result. If changing one constraint doesn't give you the results you want, then you will change another one to see what results you would then get.

Simple Models Versus Complex Models

Note, once you have changed two of the constraints you have really changed the third one. The third constraint is simply whether there is any interaction produced by changing two at the same time. This brings us to the question of effective complexity. It is better to deal with simple models initially that have just basic constraints. Although the system you are trying to represent may be more complex, try to work with that simple model. You come closer to seeing what the system is really like starting with a simple model.

Over Simplification

On the other hand I would say that in this case it is better to start out with a little more complex system. By over-simplifying you could isolate your system to such an extent that it would fit no real situation. We need to deal with something that possibly has some reality to it. For example, keep the rationality assumption. Whether you could say that the town has to be stable might be too much.

GENERALIZING THE MODEL

Comment: Is that a move to make it more general?

Model too Constrained

Hardin: Well, I am saying that at this stage your system looks like it is very constrained. In order to justify working with it you would have to get results you couldn't get some other cheaper way. What have you learned about the processes? Your key to the systems approach is the focus on the processes.

Focus on Processes

PROCESS IN HOUSING SUBSYSTEM

Rate of Deterioration

Comment: The process that is the most interesting is the rate at which housing deteriorates.

Hardin: Well, what causes this deterioration? What is the process of deterioration?

Comment: The economic forces of style obsolescence and maintenance expenditures.

Comment: Can we also say that there is an interaction between the characteristics of the occupants and the level of maintenance expenditures? Further, in

style obsolescence can we assume that the style will go out? Don't some styles come back again?

Hardin: Let's leave that topic. Can we look at the influences of the renter and the landlord. If we put in a loop we are not going to get the same results. For example, in order to learn how the system operates, we may plug in a change in the renter's behavior and try to determine how that would affect the landlord's behavior.

Inserting Loops Into the System

MODEL COMPLEXITY

Hardin: On the other hand, if you run essentially what you have, which is a linear programming technique, you are maximizing certain constraints. If the results come close to what the system seems to be doing then stop, don't go on. But if there are discrepancies then you have to begin building more complex models and open up the constraints. That will open the system but you will be getting more loops.

Feedback Mechanisms

The reason you want to increase the complexity of the model is so that you can understand the processes that operate within it. You have to deal with the system no longer in just a linear fashion where one thing follows another but you have to deal with it in terms of feedback.

BUILD CONSTRAINTS SLOWLY

If you want to understand the processes that operate in a complex system then you have to build in your constraints slowly. As you start working with a system you are attempting to understand the processes that go on. You get multiple outputs from the simulation because you have multiple changes in various aspects of the system. So, you are no longer looking at just one output.

Multiple Outputs

Input - Ouput Relationships

Now the way you would build complexity is to start talking about inputs and outputs. One output would feed into another subsystem within the same system or feed into an external system which might feed back into the first one.

Now again it will be a judgement that you will make as to what these input-output relationships are. You try to build them upon what seems to be reasonable and what other people think is probably going to hold true.

APPLYING MODEL TO RURAL NEW ENGLAND

Comment: How does this model apply to a real community? To what extent is a nonmetropolitan New England town likely to have people who build rental houses, that

is build houses specifically for rental purposes. I have this fear that the housing that is available for rent in small towns is what somebody built for himself and then moved out ~~of~~ when he got a better house. He doesn't really invest in rental housing.

Adapting the Model

Comment: I had thought that the systems approach in the form that it has been presented today might be applied to homeowners. We would have to assume that they were profit maximizing landlords, but instead of renting to someone next door, they are renting to themselves. If that requires the same thought processes and making the same tradeoffs, then this model might work for them also.

PROBLEMS OF OVER-SIMPLIFICATION

Communication Problems

Hardin : For those of you who want to make your models too simple, remember you might have to tell other persons what the components are in your model. In other words, if you go to some people and tell them some of the assumptions you have made, well, they are not going to believe you even though you get good results.

Comment: You know, that is a real problem.

Hardin : Well, it is a constraint that you have to realize because your goal is to be able to influence policies that will change the community system.

Believability of Model

Comment: Is one of our constraints the believability of our model?

RESEARCH MODEL CONSTRAINT

Hardin : Well, it is not a constraint on your system model; it is a constraint on the research model that you are using. Possibly you will attempt to go from a simple model to a complex model. What are the constraints upon this pattern of operating? What is the believability of your technique?

GREAT EXPECTATIONS

Output of Systems Approach

Let me comment on a related issue. I have had a feeling for a while now that you expect the systems approach to do too much. Basically, the systems approach gives you the framework around which to do research. The framework sets up some questions like, what is a goal of a system? What are the constraints on it that you have to identify? What level are you talking about?

Now, by the time you have answered these questions you are going to choose your technique. The technique that we have just gone through is simulation where you use a type of systems analysis. This helps you to see

what you are doing. As a research model, systems analysis helps you formulate your research questions. For instance, what is adequacy, effectiveness or efficiency for your model? You make general assumptions to find out how things are.

TESTING ASSUMPTIONS

Testing Rationality of Buyers

Comment: An example of one of the assumptions we made was the rationality of the buyer. We assumed that buyers behave rationally. It could very well be that in our feedback process we might run across a sociologist that says that the interaction is not rational. So you might want to take a sub-research project that would be to study the phenomena and relationship between landlord and tenant. Is it in fact rational, and under what circumstances is it rational, and under what circumstances is it irrational. You could put some numbers with that assumption and say 93.7 percent of the time it is rational.

Research Literature

Hardin : Or, you could just as easily go to the literature to see if there is some other research that I don't have to do. Where do I go to find out some research that has possibly been done? Or where do I go to the other departments to see if someone else has done some work on that. You don't have to do everything. By treating the research system as a totality, you can draw from the other disciplines quite easily.

APPLYING MODELS REGIONALLY

Comparing Use in States

Comment: Now, let's take a look at a model for regionality. If you want a model to be used regionally what you do is take it and test it in Pennsylvania, West Virginia or wherever you want. See if it applies. See if it works there. If it works there, then you can start generalizing.

Comment: If it works in one state and not in another, we have to figure out why it doesn't work.

Isolating Differences

Hardin : Is there a difference in constraints? Is there a difference in inputs? In other words, you've got a basis from which to ask why a model that works over here is not functioning over there.

Prediction as Test of Model

Comment: How do you tell whether a model is working or not?

Hardin : The only way I know to test any model is to predict something from it and if the prediction is right then it is highly likely that the model is good. There is no way of testing a model other than that.

CRITERIA FOR JUDGING PERFORMANCE OF THE SYSTEM

Effectiveness of What?

Output, in our terms, is our judge of performance. The reason we have defined a system and are looking at it is to show that in using effectiveness as one of the outputs, we can improve the effectiveness of the systems. But, are we talking about improving the effectiveness of the total service of the region or improving the effectiveness for each individual state?

IS THE SYSTEM REGIONAL?

No "Regional" Services

Comment: You've always got to come back to the political realm. There are no "regional" services as such. You've got to optimize the delivery of services by states and in the process this will raise the general level of the region, I would say. The state is basically the provider, there is no regional provider. In other words, to think of a model for the system that encompasses the region is not to be talking about a unit that is interested in its survival at that level. That is not the right system.

Hardin : I think you said that there is no viable system at the regional level and, therefore, to do research at the regional level may be meaningless. You've got to go back to each individual state and do research.

Regional Research Not Practical

Well, that doesn't mean that you can't come together and hypothesize about research procedures for the total region. It may, however, mean that to go out and do research for the total region is not practical.

SPECIFYING THE OUTPUT OF THE SYSTEM

Comment: Yes, but we will have some difficulty with that. I am really having difficulty thinking of our system as the consumers of community services in the Northeast. What is the output? If that is our system, what does that mean? I can think of a provision system of community services in the Northeast. It has an output that is consumed by the people who live in the Northeast. If you talk about systems or the output of systems being inputs to other systems now, the output of the system under analysis is services. Then what is the system under analysis? It is an aggregation of the service delivery systems. Well some of these service delivery systems are in fact or do in fact have outputs that reach well across six, eight, ten, twelve, states.

System: Aggregation of Service-Delivery Systems?

Possible Creation of Regional Services

My feeling is that we are looking for the creation of a regional system. In other words, in this research, we may be hoping the states will get together across their

boundaries and cooperate to work as a system at the regional level. That may not be the case at the present time. We are looking for a system at the regional level in each of these service areas which in some sense has the survival attribute.

Hardin : What you may be trying to do is to verify the hypothesis that if we could get the services to cooperate at the regional level then they would be more effective.

Vertical Integration Over Horizontal Integration

Comment: I disagree. Let's look at it another way. These services-delivery systems operate through political systems through all of the states in the Northeast, through each particular state, and through the local area. So we have different control systems through which the services-delivery systems operate. Basically, they operate vertically with not very much contact horizontally in terms of delivery. That is the kind of picture of the existing systems which now operate. Therefore, I don't think we can get into regional research involving regional systems. I don't think these systems can be defined.

Goal: Improved Services in Region

Comment: Isn't what we are thinking about improving, for example, the adequacy of the health system throughout our region and recognizing that there are many differences in adequacy throughout the region? We are trying to bring about an improved level throughout the region. So, to that extent, it is a regional system.

Comment: This system is not a regional system, it is a state system, that is, subsystems by state.

THE RESEARCH COMMITTEE AS A SYSTEM

Comment: I can see you two are not going to agree. Can we start at another point of analysis? Rather than starting out determining what the system is with regard to the services, maybe it would help if we looked at ourselves, the research committee, as a system. Determine what our goals are and what our constraints are; we all know them. Then, given our constraints, processes, inputs and outputs, we can more or less define the maximum system or the larger system that we can deal with. Otherwise we have got to start with the universe and go down to the United States, then down to the region, etc. Once we have stated what our processes, goals and constraints are, then we know exactly what the larger system is that we can begin with.

Specifying Research Goals

Research Constraints

Our goals are stated in our project output. Our constraints are the number of people we have and the fact that none of us can go too far outside of our state, or the region. We have the region as a boundary. We are limited at this time to three community services. We have several states in our region which are not represented on the Technical Committee. All these facts are constraints.

WHAT ARE THE OUTPUTS OF THE SERVICE-DELIVERY SYSTEM?

Hardin : I still think you have to face how you are going to judge the service outputs of your region. You've got constraints and within these you must plan your research. But, as a research system or group you still have to be able to specify what output you are looking for.

POINT OF PROVISION AND POINT OF UTILIZATION

Comment: That is the very thing Scott Urquhart and Garrey Carruthers wrestled with in the paper they wrote, [Some Methodological Considerations for Rural Community Services Research]. Remember they talked about studying service-delivery systems at the point of provision or at the point of utilization, i.e., where the services were generated, the provider point or where they were consumed, the point of utilization. A point of utilization was the household and the study they did this summer [1972] went into the latter point of view. In other words, they said the output from the service-delivery systems is consumed by households, and this influenced their subsequent analysis. If you define the output as being inputs to family systems or households then this says that adequacy has got to be defined that way.

Output Defined

Adequacy Defined

OUTPUT SPECIFICATION NECESSARY FOR RESEARCH

Hardin : It is hard to research adequacy until you know how you are going to judge output. Once you determine how you are going to judge the system's output, it leads you to what you are going to look at, or how you can investigate it.

TENTATIVE DEFINITION OF THE MODEL

Comment: We may have assumed that our objective was very similar to what Garrey Carruthers stated. The ultimate consumers of the services were the families or individuals who receive them and that our objective was, first of all, to determine the adequacy and quality of the services that they receive and, then, to determine ways which would improve the quality of these services. Our metropolitan restriction was only a means of defining who or which of the infinite number of consumers we were going to study. And once we made that definition, the non-metropolitan versus metropolitan has no particular relevance other than that the consumers may receive some of these services in areas that we define as metropolitan rather than nonmetropolitan.

Goal Defined

System Boundaries

Comment: Then are we saying that our broad system is all consuming households?

System Defined

Comment: Well, the inputs should be for all consuming households in nonmetropolitan areas. Our finding should be applicable to all consuming households in nonmetropolitan areas.

Comment: Does that create a sampling problem?

Comment: Yes, there is a very real sampling problem.

CONCRETIZING THE MODEL

System Definition Refined

Comment: The major system we want to study in the ten state area is all of the nonmetropolitan consuming households and all of the providers of those things consumed.

Comment: And, we arbitrarily said for only three services.

Comment: The system we will research is made up of, or has boundaries which include, all consuming households within nonmetropolitan areas of ten northeast states and the providers of the three community services.

ADDITION OF SEASONAL HOUSEHOLDS AND TRANSIENTS

Comment: We should expand this to include all year round and seasonal households. We should include all year round and transient people.

LINKAGE SYSTEMS

Linkage Between Systems

Comment: What is the output of that system? I would like to suggest that what we are really interested in is the linkage between the system of providers and the system of consumers. For example, we are interested in the output of households in terms of the tax payments as an input into the provider system. We are not interested in all outputs of the consuming households. We are not interested in all outputs of the provider systems. We are interested in simply those outputs that link the consumer and provider systems.

Comment: But, what is the output of the total system?

OUTPUT IS EFFECTIVENESS OF DELIVERY SYSTEMS

Hardin : Well, the system they are talking about includes the providers of these services and how the services get to the consumer. The output of the system they were talking about is helping us determine what the system processes are and what should be the criteria of judgment for how the system is doing. The output is how effective or adequate the total process is for services. Now, how do we measure this output? This question is important because if you start change you've got to be able to measure what happened.

Output Redefined

Problems of Measuring Effective Service

Comment: Well, just to expand on what you are saying, the only reason to study the consumer is to be able to evaluate the output. If we were talking about the production and marketing of potatoes we would go to the store counter. The potatoes would be there and we could grade them and see what their quality was. But, because we are talking about a service, we can't do that. We've got to interview the consumer because he is the one who uses this service.

Consumer Roles

Comment: You can think of consuming as one role that the people have who live in a geographical circumscribed area. Another role has to do with community decision-making impact on the nature of service delivery system. So, I think you are wrong when you say that the only reason you want to look at consumers is to judge the quality of the service itself. You also have to consider their role in the service-delivery system. The same consumers may also be making provider-type decisions.

Correlation with NE-80

Comment: Also, if we conceptualize as our system, the community services and households who consume the services, then maybe NE-80 [Processes of Rural Economic Change in the Northeast] can pick up our output. The output of our system is employable, healthy, housed, educated persons. This output becomes the input for the NE-80 employer system. Their output is expendable income.

REVIEW OF ANALYSIS

Comment: What exactly have we done so far? Could we review?

General System

Hardin : We started off trying to look at the general system that you want to examine. We have found some problems in integrating your research of three subsystems. To integrate means you've got to have a larger system that you are concerned with; otherwise you couldn't possibly communicate or talk about this system. If you are going to predict or try to change a subsystem you have to judge it upon the larger system, because although the planned change may prove beneficial for the health services area, it might prove detrimental to the educational area.

Integration

Defining Criteria

Now before we can say what subsystems are worthy of research and at what level we want to look at the system or subsystems, we need to find the criteria upon which we will be judging the system. That means we have to have some measure or some concept of output. For instance, do we want to improve the services? If so, in what way? Are we going to do it for the individual? Is that going to be our criteria for judgment or do we want to do it for groups or for states? Once you have decided that, then you can go down to the subsystems and try to relate it to the larger system.

Subsystems Related to Larger System

Key: Establishing the Problem

Your success depends on setting up your problem, or your system correctly. The heardest part is getting down clearly what system you are talking about.